Ju 87 STUKA VS ROYAL NAVY CARRIERS

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INTRODUCTION

Following experience gained in the air during World War I and ensuing conclusions on tactics, the military planners of Germany's post-war *Reichswehr* began, quietly and covertly, to consider the potential advantages and practicalities of dive-bombing. Their ambitions were limited by the restrictions imposed upon them by the terms of the Treaty of Versailles, but as early as 1925, Hauptmann Hellmuth Felmy, an officer within the *Heereswaffenamt*'s (Army Weapons Office) Department T1, proposed a *'Sturzkampfflugzeug'* (dive-bomber) as a fundamental element in plans for a new, independent tactical air force for when Germany would be free of the shackles of the Treaty.

Throughout the late 1920s, Germany and other nations, such as Japan, China and Sweden, had experimented with dive-bombing. In his work on maritime machines, the aircraft designer Ernst Heinkel endeavoured to incorporate precision bombing capability – an important prerequisite when striking 'small' targets, such as ships, from the air.

Of more significance, and cause for encouragement, however, were the tests conducted with the Junkers K 47, a strong, all-metal, high-wing monoplane fighter fitted with a 480hp Bristol Jupiter VII air-cooled radial engine which first flew in 1928. It was also fully stressed for diving. In order to circumvent the terms of the Treaty, in 1933, with the experienced, wartime-veteran Junkers test pilot and world altitude record-holder Willy Neuenhofen at the controls, the K 47 carried out 26 dive tests at the Bofors works in Sweden. To conform to the desire to dive-bomb, Junkers' chief designer, Diplom-Ingenieur Ernst Zindel, arranged to fit basic bomb racks capable of carrying ten 50kg and four 25kg bombs, as well as an experimental bombsight, a direction gyro, an altimeter and a recording camera to monitor the vertical bombing. Later, dive brakes and an automatic recovery system would be added in Germany.

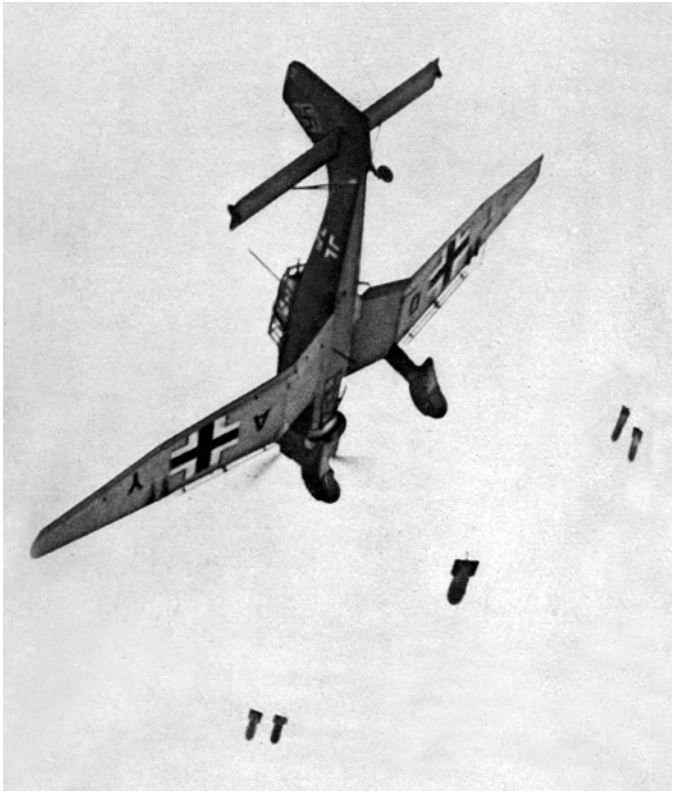
The trials were viewed as a success, and a second stage of tests took place at Rinkaby, also in Sweden, in August and September 1933. Tellingly, in these trials a mock warship was the target. Nineteen bombs of between 13kg and 50kg in size were dropped from the lower altitude of 1,060m, with release at 800m. The K 47 achieved a 60 per cent hit rate, demonstrating a level of accuracy far more impressive than that which could be achieved through horizontal bombing. Tests in Sweden continued into 1934 using a locally-built K 47 alongside British Hawker Harts that Sweden had purchased. Once again the tests produced impressive results, leaving the Swedes and Germans convinced that dive-bombing had a future.

They were not alone. In Britain in December 1934, Hawker introduced the P.V.4, a general purpose, two-seat light bomber designed as a private venture project to meet specification G.4/31 for a 'Standard General Purpose' aircraft capable of tropical or temperate operation that could perform conventional or dive bombing. This all-metal biplane could carry up to 570lb of bombs and could operate readily as a dive-bomber. The prototype, the I.P.V.4, first flew on 6 December 1934, but despite being the fastest of several contenders for G.4/31, the aircraft was considered to be too slow for lower-level bombing operations from an altitude of 6,600ft and it never entered production.

The following year, the American firm Curtiss-Wright produced the SBC Helldiver, a two-seat scout bomber and dive-bomber intended to satisfy the US Navy's initial requirement for a two-seat monoplane with a parasol wing and a retractable undercarriage. In August 1936, the US Navy signed a contract for 83 SBC-3s (the Curtiss Model 77A), which could carry a 500lb bomb on the fuselage centreline. VS-5 took delivery of the first SBC-3s from July 1937 in readiness for operations from USS *Yorktown* (CV-5), but this carrier would not be commissioned until 30 September 1937 and the squadron finally went aboard on 10 December that year. By June 1938, as production stepped up, Helldivers were also serving on the carriers USS *Saratoga* (CV-3) and USS *Enterprise* (CV-6).

Meanwhile, in Germany, the appetite for dive-bombing had not abated. The foundation laid down by Felmy back in 1925 had, slowly but surely, been built upon, and its new architects held influence. In a visit to the USA in 1931, Ernst Udet, Germany's second highest-scoring fighter pilot of World War I who had embarked on a post-war career as a flying stuntman, international aerobatics champion and an unsuccessful aircraft builder-cum-entrepreneur, witnessed US Navy pilots publicly demonstrating their Curtiss Hawk biplanes as dive-bombers. Subsequently, Udet visited the Curtiss plant at Buffalo, where he flew the US Navy's F11C-2 Goshawk, a biplane powered by a 740hp Wright Cyclone engine that could carry a single 110lb bomb. Udet was excited by what he had seen.

In November 1933, following the Nazi Party's assumption of power in Germany, Udet enthused General Hermann Göring, the nascent Reichs Minister for Aviation, sufficiently for him to authorise the purchase of two Hawks, as the export version of the F11C-2 was known. The two aircraft arrived at the main German aeronautical test centre at Rechlin in December 1935 and were then transferred to the Tempelhof test facility in Berlin, where Udet, by now a member of the Luftwaffe himself, tested them. These flights failed to impress or influence the new, incisive class of senior Luftwaffe technical men such as Erhard Milch, Albert Kesselring and Wolfram von Richthofen, however, although Udet's efforts



The unmistakeable view of a Ju 87 finishing its dive, the pilot having dropped the aircraft's ordnance of a 250kg bomb via its release trapeze and four 50kg bombs from underwing racks. Seconds later, the aircraft would briefly level out, then pull back up to a higher altitude. The extended dive brakes are also visible here. (Robert Forsyth)

and personality kept a flickering flame of hope alive for the prospect of further German dive-bomber development.

In January 1936, Oberst Udet was appointed Inspector of the Fighter Arm. On the 24th of that month, test pilot Willi Neuenhofen, who had played such an important role in assessing the K 47 as a dive-bomber during tests in Sweden, and engineer Heinrich Kreft were killed test-flying the prototype of a somewhat ungainly looking new Junkers design, the Ju 87. The crank-winged aircraft was seen as a new dive-bomber, but during the flight on that winter's day, the Ju 87's tail unit had begun to oscillate while in a vertical dive and the starboard tailfin broke away. The Ju 87 V1 went into an inverted spin and crashed into the ground at Kleutsch, not far from the Junkers works at Dessau. It was not a good omen, and yet before the year was out, an example of the aircraft would arrive in Spain to make its operational debut with the Luftwaffe's *Legion Condor* in that country's catastrophic civil war. It would go on to become one of the most recognised aircraft in aviation history.

NAVAL AVIATION

In 1911–12, the Italo-Turkish War introduced to the world the first three-dimensional international conflict; that is to say a war in which land, sea and air forces all saw deployment, the Italians heralding the aeroplane's appearance in military conflict, along with lightly-armed, pre-dreadnought battleships. Within just six years, at the end of World War I in November 1918, it had become clear to the leading belligerents that the effect and influence of aircraft upon naval warfare would only increase. Britain, drawing on its war experiences and as the leading naval power at the beginning of the 20th century, pioneered the development of naval aviation. Even as the first shots had been fired in the Italo-Turkish War, the Royal Navy had carried out innovative experiments in the launching of aircraft from the decks of cruisers and from platforms built over the gun turrets of battleships.

In August 1917, the Courageous-class battlecruiser HMS *Furious* was converted to become an aircraft carrier, with a 'flying off deck' fitted at the forward end of the ship and a 'flying on deck' added behind the superstructure – small gangways allowed the movement of aeroplanes between the two decks. On 2 August, a Sopwith Pup landed

on *Furious* at Scapa Flow in an experiment, and in doing so became the first aeroplane to land on a moving ship.

But the design and practical use of flightdecks proved tricky. From the autumn of 1918, aircraft platforms were fitted to the gun turrets of 22 light cruisers to compensate for the lack of dedicated carriers, of which the Royal Navy had three – *Furious*, *Argus* and *Vindictive*, although it was only *Argus* that possessed an unobstructed flightdeck which allowed, just about, risk-free landings.

However, throughout the following two decades after the war, despite budget cuts that curtailed fleet development, on a paradoxical tide of expansionism, Britain constructed the first purpose-built carriers. These warships had single flightdecks running the length of a vessel and either no superstructure or a small island located amidships on the starboard side. And despite the fact that from such carriers, aircraft could be launched to bomb land targets or to defend the surface fleet, during much of the inter-war period they were predominantly used only as floating reconnaissance platforms. Carrier aircraft would merely search for the enemy, perhaps launch a torpedo and act as an artillery spotter for the big 14- or 16in. guns of the battleships, which would fire their 1.5-ton shells. Carriers might assist in naval tactics, but it was the battleship that remained supreme.

However, because of financial and organisational snags, and while still the leading naval power in 1918, the Royal Navy's ensuing plans for seven fleet aircraft carriers and a number of light carriers foundered, and thus began the 'withering on the vine'. Throughout the 1920s and well into the 1930s, the Royal Navy struggled on with six carriers – *Argus*, *Courageous*, *Eagle*, *Furious*, *Hermes* and *Glorious* (*Vindictive* had been reconverted into a cruiser in 1923).

Despite this, in September 1935 a new fleet carrier, HMS *Ark Royal*, was laid down at the Cammell-Laird yard on Clydebank, followed successively in April, May and June 1937 by HMS *Illustrious* at Vickers-Armstrong in Barrow-in-Furness, HMS *Victorious* at Vickers-Armstrong in Tyneside and *Formidable* at Harland &

Amidst a slight swell, *Illustrious* is seen in profile with three Fulmars and two Swordfish on its flightdeck. The carrier is painted in one of several high- and low-contrast disruptive camouflage schemes that were applied in 1941. (armouredcarriers.com)

Wolff in Belfast. Finally, HMS *Indomitable* was also laid down in Barrow-in-Furness in November of that same year. These five vessels were launched between April 1937 and March 1940, with *Ark Royal* being the first to be commissioned in November 1938 and *Indomitable* the last in October 1941.

By 1939 the Royal Navy counted six aircraft carriers in service, the oldest, HMS *Eagle*, a converted ex-Chilean battleship, having entered British service in 1920. On the eve of World War II, the veteran carrier was capable of embarking a complement of 18 Swordfish biplane torpedo-bombers. The vessel had been followed into the fleet by the first purpose-built carrier, HMS *Hermes*, in 1923, and it could embark nine Swordfish in 1939. Between 1925 and 1930 three more carriers – *Furious*, *Courageous* and *Glorious* – also went into service. Reconstructed World War I cruisers, these ships carried larger, mixed complements of Swordfish, Skuas, Rocs and Sea Gladiators in 1939. As mentioned, *Ark Royal* joined in 1938.

Even with these carriers, however, progress in naval thought was slow. It was not until the outbreak of World War II in September 1939 that the practise of draining the fuel tanks of aircraft stored away on board carriers in a measure designed to prevent fire during an attack by enemy aircraft was rescinded. Naval thinking was that aircraft would not be needed to 'scramble' quickly from the deck of a carrier because barrages of anti-aircraft fire would defend a ship sufficiently and, in any case, aircraft would be unable to sink a vessel the size of a mighty carrier – a misguided notion. It was a notion the origins of which lay in the belief that, as an island surrounded by the English Channel, the North and Irish Seas and the Atlantic Ocean, Britain could only be threatened by naval aggression, but that the strength of the Royal Navy would neuter any such prospect.

Yet even as Britain and Germany went to war, and the realisation that *bombing from the air* posed the new threat, Britain had still not developed an offensive doctrine for its aircraft carriers despite the fact that the Royal Navy was the world's leading operator. Britain had only a small number of naval airmen and carrier-capable aircraft, lagging behind America and Japan. Despite the extent of its empire, the conservative views of British naval strategists meant that they foresaw carriers operating cautiously only in narrow seas around Europe and the Mediterranean, as well as in the Far East, where they would be vulnerable to attack by land-based enemy aircraft and submarines. Indeed, the Luftwaffe was contemplating such attacks, although it did not possess specialist anti-shipping aircraft able to launch torpedoes. British naval policy was to play the waiting game, which resulted in a reactive rather than a proactive stance, despite the advances of the US and Japanese navies.

For his part, Hitler believed that Britain could be defeated by severing its arterial supply routes, but the lack of a strategic, long-range bomber impeded the *Führer*'s ambition. As the historian R. J. Overy has commented, 'The early successes enjoyed in the trade war were a reflection not of large-scale German preparation but of the fact that British preparations were even poorer.' It would be in the coming three years of war that the precarious balance between inadequate carrier provision by the Royal Navy and an insufficient numbers of bombers with which the Luftwaffe could effect strategic change in a distant theatre of operations would be tested.

CHRONOLOGY

1917

2 August Sqn Cdr Edwin Harris Dunning of the Royal Naval Air Service makes the first landing of an aircraft on a moving ship when he lands a Pup on the flying-off deck of *Furious* in Scapa Flow. Dunning was killed when making a second attempt.

1920

11 February The Naval Anti-Aircraft Committee recommends development of a multiple pom-pom to counter low-flying aircraft attacking ships with torpedoes and explosive boats controlled by aircraft.

1933–34

Junkers test pilot, Flugkapitän Wilhelm (Willy) Neuenhofen, undertakes dive-bombing tests with the Junkers K 47.

1935

7 July Junkers Ju 87 V1 completed and subject to RLM inspection.

17 September First flight of Ju 87 V1 Wk-Nr 4921 at Dessau, piloted by Flugkapitän Wilhelm Neuenhofen.

1936

24 January Neuenhofen and his engineer, Heinrich Kreft, killed in the crash of the Ju 87 V1.

The distinctive shape of the Ju 87B, with its cranked wings, chin radiator fairing and large wheel spats, is captured in an officially released still from a propaganda film, as the pilot glances at the cameraman from his cockpit. Note the large underwing crosses to aid recognition and the racks for mounting 300-litre drop tanks or pairs of 50kg bombs. (Robert Forsyth)

1937

27 April Fleet carrier *Illustrious* laid down at Vickers-Armstrong, Barrow-in-Furness.

17 June Fleet carrier *Formidable* laid down at Harland & Wolff, Belfast.

10 November Fleet carrier *Indomitable* laid down at Vickers-Armstrong, Barrow-in-Furness.

1938

January Ju 87 V4 available to VJ/88 of the *Legion Condor* in Spain for operational assessment.

1939

5 April *Illustrious* launched.

1 May I./StG 1 forms at Jüterbog and II./StG 2 at Stolp-Reitz, both with Ju 87Bs.

17 August *Formidable* launched.

18 November *Stab*/StG 1 forms at Jüterbog with Ju 87B.

1940

26 March *Indomitable* launched.

April Ju 87s of I./StG 1 attack Royal Navy vessels for the first time, off Norway.

25 May *Illustrious* commissioned.

11 June Malta attacked for first time from the air by aircraft of the Regia Aeronautica.

9 July I./StG 3 forms at Barly with the Ju 87B.

2 September *Illustrious* engages 15 Ju 87s of the Regia Aeronautica's 96° *Gruppo*.

24 November *Formidable* commissioned.

1941

2 January First Ju 87 (from *Stab*/StG 3) arrives in the Mediterranean at Trapani as part of X. *Fliegerkorps*. Around 80 more Stukas from I./StG 1 and II./StG 2 fly in over the next few days.

10 January As part of Force A of Operation *Excess*, *Illustrious* comes under attack west of Malta from 43 Ju 87s of I./StG 1 and II./StG 2. The carrier is badly damaged and leaves the convoy to escape to Malta.

26 May *Formidable* attacked by II./StG 2 off Crete, after which the carrier's Fulmars pursue the Stukas.

10 October *Indomitable* commissioned.

1942

20 June Tobruk falls to the Afrika Korps.

11–13 August During Operation *Pedestal*, a key supply convoy to Malta is escorted by Rear Admiral Lumley Lyster's carrier squadron, comprising *Victorious*, *Indomitable* and *Eagle*, with 72 fighters embarked between them, and later reinforced by *Furious*. *Indomitable* is attacked by 12 Ju 87Ds of I./StG 3 flying from Sicily.

DESIGN AND DEVELOPMENT

Ju 87 – PROTOTYPES TO THE *'BERTA'*

Unlike its later appearances in the skies over Poland, the Low Countries and the beaches of Dunkirk, the combat debut of the Ju 87 in Spain was somewhat less auspicious, but it nevertheless caused impact and was impressive. Just three of the new all-metal Ju 87As had been transferred to the *Legion Condor* on 15 January 1938, and from 17 February they were used to clear the way for Nationalist infantry at Villalba, ten kilometres north of Teruel on the Rio Alfambra. Despite not causing a breakthrough in the enemy line, the results of the big, inverted, gull-winged, dive-bombers dropping their 250kg bombs in repeated, pinpoint attacks against the Republican positions gave cause for optimism to German commanders. Despite attacking the wrong target and their bombs falling wide, this advanced *Sturzkampfflugzeug* could be seen as a weapon that would synchronise perfectly with existing German battlefield doctrine, and it left the *Legion*'s commanders with high hopes. Optimistic reports were sent back to the technical departments of the *Reichsluftfahrtministerium* (RLM – German Ministry of Aviation) in Berlin.

The two men with whom the Ju 87 chiefly originated were former World War I pilots Diplom-Ingenieur Hermann Pohlmann and Karl Plauth. A native of Munich, Plauth had commanded the Fokker D VII-equipped *Jasta* 51 from September 1918 and ended the war credited with 17 victories. Post-war, he studied engineering at the

The designer of the Ju 87, Diplom-Ingenieur Hermann Pohlmann (centre, wearing a suit), in conversation with members of the Junkers workforce possibly around 1939, before Pohlmann left the company to join Blohm und Voss. The Ju 87B immediately behind them was probably being used for testing and trials. The cockpit canopy to this aircraft is open, while the second machine has been covered in a tarpaulin for protection against inclement weather. (EN Archive)

OPPOSITE

Ju 87R-2 T6+AC of Major Walter Enneccerus, *Stab* II./StG 2, saw combat over North Africa and the Mediterranean in 1941. As with many Stukas in-theatre, this aircraft retained its northern European splinter pattern camouflage of RLM 70/71 greens with 65 undersides, which was also applied to the 300-litre drop tanks. The Ju 87 carried the Mediterranean theatre fuselage identification band and an emblem featuring a Luftwaffe eagle and Swastika superimposed over a palm tree (on the starboard side of the nose only), which was used by the elements of StG 2 while they were in North Africa. White vertical bars were applied to the front of the wheel fairings.

Technische Hochschule in Darmstadt, and while a student there designed three gliders. Plauth joined Junkers in March 1923 and was responsible for the A48, the firm's first post-war, smooth-surface, all-metal aircraft. From this design, he began to focus on the concept of a dive-bomber, but his work was cut short when he was killed in a sports flying accident on 1 November 1927.

A former bomber pilot with the *Luftstreitkräfte* in World War I, during which time he had served in Italy, Hermann Pohlmann had been shot down over Christmas 1917 and taken prisoner of war by the British. After the war, he studied ship design, before joining the Junkers Flugzeugwerke in 1923, where, initially, he worked on the engine cowlings of the Junkers G23. As early as 1928, Pohlmann was part of the design team for the K 47 (see Introduction) along with Karl Plauth, laying the foundation for the eventual Ju 87.

In the wake of the crash of the Ju 87 V1 (as also recounted in the Introduction), Pohlmann, by this time the chief designer at Junkers, and his team removed the defective installation of a tail assembly with twin tailfins from the design and in the following Ju 87 V2 Wk-Nr 4922, the single fin and rudder from a K 47 was adapted and fitted. This second prototype flew on 23 February 1936 fitted with dive brakes and strengthened by steel plates and reinforcing brackets. There were plans to install

Ju 87R-2

a Daimler-Benz DB 600A engine into this aircraft, but this never eventuated due to the powerplant's unavailability.

The V2 was followed by V3 Wk-Nr 4923, with an identical single fin and rudder tail assembly, the aircraft making its inaugural flight on 27 March. Both Ju 87s were powered by a single 700hp, 12-cylinder, liquid-cooled Jumo 210Aa engine driving a three-bladed metal propeller. They differed, however, from the V1 in having smaller chin radiators. The V3 also had its engine, which drove a three-bladed variable pitch propeller, mounted lower than the V2 in order to provide improved visibility from the cockpit. Furthermore, the tailfin area was enlarged and two faired mass balances were added for the elevators at the ends of the tailplane.

The V2 took part in assessment tests at the RLM's main test centre at Rechlin in the spring of 1936, where, on 26 May, while flown by Flugkapitän Diplom-Ingenieur Peter Hesselbach, it carried out an almost vertical dive from 3,500m carrying an underslung 500kg bomb. The aircraft was built with a more conventional cruciform empennage, with a large central fin and rudder intended to prevent spinning, while the dive brakes ensured that the V2 remained stable at speeds of around 450km/h. In July the aircraft performed well against competing dive-bomber designs from Arado (Ar 81 V3), Blohm und Voss (the gull-winged Ha 137 V4) and Heinkel (He 118 V3), with the result that the Arado and Blohm und Voss prototypes were discounted. When Udet subsequently went into a dive while flying the more powerful, two-seat He 118 monoplane, the propeller fell away, and thus the Ju 87 won the day. Junkers received the order to commence production, despite the fact that the Heinkel was faster and had a modern internal bomb-bay and retractable undercarriage.

Not everyone was a supporter of the Ju 87, with the aeroplane proving divisive among leading figures in the RLM. As far back as 1934, the head of the aircraft development, testing and evaluation department in the Technical Office, Major Wolfram Freiherr von Richthofen, had been unconvinced by the entire notion of dive-bombing. His reservations were founded principally on the fact that a dive-bomber would be particularly exposed to ground fire during its dive. Von Richthofen had an ally in Generalmajor Erhard Milch, the Secretary of State for Aviation, who believed that the high gravitational forces experienced during a dive would prove too great for a crew, and thus the dive-bomber was flawed. But the insightful Generalmajor Walther Wever, the Luftwaffe's Chief of General Staff, was an enthusiast, believing that a short-range dive-bomber capable of quick, pin-point accuracy would provide critical tactical support to ground forces where high-altitude, horizontal bombing would be much less accurate.

Ju 87 V4 Wk-Nr 4924, which made its maiden flight on 29 June 1936, became the first prototype of the A-0 pre-production series, the A-model being referred to as the *'Anton'* series. The V4 differed from its predecessors in having an almost straight wing leading edge, as opposed to the double taper of the earlier wing. It also had a more aerodynamically shaped radiator, a longer, more streamlined canopy, smaller undercarriage fairings and a trapeze frame attached to the central underside fuselage to allow sufficient clearance of a bomb from the arc of the propellers when released.

Ju 87A-1 Wk-Nr 0012 D-IEAU is photographed here in 1937–38, probably at Dessau, in the early style RLM 61/62/63 splinter pattern camouflage with RLM 65 undersurfaces, early national markings and civil code letters on its upper wing surfaces. Note the small number '12' on the rear fuselage beneath the horizontal stabiliser. The aircraft had the early style canopy and wide wheel spats. (EN Archive)

A single, forward-firing 7.92mm MG 17 machine gun was fitted in the port wing, as well as a cockpit-mounted, rearward-firing MG 15.

As with the V2, the V4 was sent to Rechlin in November 1936, where it undertook a range of ordnance tests from early the following year. The weight of the aircraft in relation to the power of the Jumo 210 engine meant that loads had to be capped at 500kg with only one crewman carried. During these trials the Jumo 210Aa was replaced by a Jumo 210Ca rated at 640hp. The main objective of the tests was to assess fuses and bomb dispersion patterns with standard 250kg and 500kg weapons and anti-personnel bombs.

The V5 and V6 followed, both being prototypes for the B-0 series. A run of 11 A-0s was produced at Dessau commencing in June 1936 and delivered to the first Stuka *Gruppe* to be formed, I./StG 162, for operational evaluation. The first A-1s were built in early 1937, with 27 examples being delivered by 30 November that same year. The A-2 that followed incorporated broader propeller blades to control and limit terminal diving speed since it was foreseen that the Ju 87 would need to dive as close to the ground as possible to achieve the highest accuracy. This, in turn, meant that the aircraft would need to pull out at low speed in order to reduce the forces on its airframe.

Junkers had initially intended to install the *Stukavisier* (*'Stuvi'*) rudimentary bombsight into the Ju 87 following its creation in 1934 and subsequent progressive development. By March 1936, however, it was decided to fit the *Stuvi* A2 bombsight once it had gone into production, and this device would replace an interim Junkers auxiliary sight.

In August 1936, amidst conditions of great secrecy, the V4 was shipped to Spain for operational testing by VJ/88, the fighter(!) evaluation unit of the *Legion Condor*. Results were not particularly encouraging, and von Richthofen, who had been sent to Spain to evaluate aircraft in operational conditions, remained sceptical about the Ju 87. Its durability in primitive conditions was noted, but the single, defensive rear gun was found to be badly sited for ground-strafing and considered inadequate. Even the aircraft's performance in its principal role gave cause for concern. Six attacks were

A freshly completed, bare metal Ju 87B-2 is hoisted off the factory floor at Dessau in readiness for the application of paint. The hoisting lines are fitted to what were the official attachment points on the fuselage, and the radiator grill has a cover over it. Note the Ju 88 airframes undergoing completion in the background. (Robert Forsyth)

flown with the 250kg bomb, as well as some test dives. The target line-up observation window in the pilot's floor rapidly oiled over in flight, rendering it useless for its purpose.

On a more positive note, in the dive itself, the dive brakes performed as planned, holding the aircraft's terminal velocity to 450km/h. Dives were commenced at around 3,500m, with bomb release at 1,000m. Target approach and exit speeds were, however, severely criticised as being far too slow, being at least 100km/h lower than the minimum required to operate without fighter protection.

When it was suggested to von Richthofen that the Ju 87 be deployed against ship targets in Malaga, he scoffed in his diary, 'That won't work, since (1) a solo flight with one engine over such a wide Red territory is irresponsible, and (2) the *Stuvi* A3

bombsight, despite informing *Leiter* LC II at the Technical Office in Berlin, has not been sent to us. Item will be chased-up'. Without the *Stuvi*, the *Legion*'s engineers believed that guaranteed hits on a pinpoint target would not be possible. Four days later, von Richthofen noted there were still problems with the V4's engine, and he remained sceptical about dropping tests with un-fused live bombs – 'In case success is negative, as is to be expected, the air attack required on a particular house in Madrid will have to be turned down.'

Later, as the three Ju 87A-1s of 5.J/88 (a part of the *Legion*'s fighter group) conducted operations in Spain, rather than undertaking close support missions for ground forces per se, deployment was focused against precision targets such as bridges, railway yards and other choke points. It was the belief of the RLM that using the Ju 87 as a close support aircraft was too dangerous for the small number of machines that had been sent to Spain. Also of note is the fact that during the Spanish Civil War, the *Legion Condor*'s seaplane unit claimed a total of 54 Republican ships sunk and many others damaged. By comparison, the three Ju 87s claimed just eight vessels.

To build the Ju 87, the RLM assigned license production to Weser-Flugzeugbau (Weserflug) GmbH at Bremen in November 1936 since Junkers would be fully committed to assembling the planned Ju 88 at Dessau. In April 1937, the RLM issued a production plan calling for an output of 35 Ju 87s per month. The first aircraft were completed by Weserflug in December 1937, and from late 1938 it firm took on full production – some 570 Ju 87A-0s, A-1s and B-2s had been manufactured at Dessau before Weserflug took over. The firm also turned out six B-0s and a small run of B-1s, the latter, developed from the V9, being christened the *'Berta'*. For its part Weserflug had capacity at its other plant at Bremen-Lemwerder, which delivered 137 Ju 87A-1s by the end of 1938, and further capacity existed at Delmenhorst, Einswarden, Nordenham and Berlin-Tempelhof. The firm would go on to produce 577 aircraft in 1939, 769 in 1940 and 1,074 in 1941.

The Ju 87B-1 was fitted with a more powerful Jumo 211A, producing 1,000hp. This engine benefitted from fuel injection and was housed in a revised cowling that featured an asymmetric air intake in its upper section for the oil cooler. The radiator under the nose had vertical slats, differing from the earlier horizontal ones, and the enlarged air intake was relocated to the right side of the cowling. The horsepower gain of the new engine also meant that double the bombload could be carried under the fuselage centreline, and wing racks could also be fitted. The B variant had a thinner fuselage, wheel spats and an improved canopy design. The undercarriage was redesigned, with aerodynamic, two-piece spats covering the length of the shock absorbers. Generally, it was considered easier to fly since, unlike the *'Anton'*, it did not require manual propeller pitch regulation and cooling gill movement before and after a dive-attack.

The B-1/U1 was the standard variant, and had a Revi C/12C bombsight that could be used for bombing and for firing the fixed MG 17 machine gun, while the B-1/U2 had alternative radio equipment, the B-1/U3 was fitted with additional armour and the B-1/U4 had skis instead of wheels. The B-1/*Trop* featured sand filters for the engine and desert survival equipment. The B-1 had a range of 550km.

The B-2 was fitted with the 1,200hp Jumo 211Da, but the loading of more equipment had an adverse effect on range. To compensate for this, the Ju 87R (*'Richard'*) was produced as a long-range, anti-shipping dive-bomber that featured an additional 150-litre internal fuel tank within each wing and had the ability to carry a 300-litre drop tanks under each wing. These enhancements gave the R-1 a range of 1,255km. The R-2, R-3 and R-4 sub-variants differed only in variation of equipment.

In early 1939, as an illustration of how the RLM viewed the Ju 87 as an *anti-shipping* or maritime aircraft, a further initiative came in the planned Ju 87C (*'Cäsar'*), which was intended as a specialist navalised conversion from the *'Berta'* for deployment on the *Graf Zeppelin*, the Kriegsmarine's aircraft carrier then under construction in Kiel. Two Ju 87Bs were converted to *Cäsar* configuration and they flew in the spring of 1939, but the intended production of 120 C-models never went ahead following the cessation of all work on the *Graf Zeppelin* in the spring of 1940 in favour of large numbers of coastal guns and anti-aircraft batteries.

By 1 March 1939, of an RLM order for 964 Ju 87Bs, 187 had been built, and by the end of July that number had increased to 435. It was intended to replace the Jumo 211A in the Ju 87B with the more powerful Jumo 211D once 697 examples had been completed. This would mean that the earlier Ju 87As could be withdrawn from operational units and assigned to the training schools as the Luftwaffe expanded and created new Stuka *Geschwader*.

Meanwhile, on 16 March 1939, as the factories continued to turn out the aircraft that would become the enduring symbol of *Blitzkrieg*, Adolf Hitler had arrived triumphantly at the Hradcany Castle in Prague. Twenty-four hours earlier, German troops had entered the remaining territory held by the Czechs in Czechoslovakia. In an ominous instruction issued to newspaper editors, the German propaganda minister, Josef Goebbels, wrote, 'The use of the term *Grossdeutsches Reich* is not desired. This term is reserved for later eventualities.'

ILLUSTRIOUS-CLASS AIRCRAFT CARRIERS

As outlined in the Introduction, throughout the 1920s and 1930s, as a result of fiscal restrictions, the Royal Navy and the Fleet Air Arm relied on just six carriers, but in 1937 this situation was relieved to some extent by the launching of the 22,000-ton *Ark Royal*, the third vessel to bear that name. This new warship was built with an armoured flightdeck complete with a safety barrier, and could carry 72 aircraft in two hangars. *Ark Royal* represented a definite advance in carrier design, with naval historian Kenneth Poolman describing it as 'the symbol of a great renaissance of naval strength and modern striking force.' The ship also provided the foundations for the following Illustrious-class of conventional, fixed-wing aircraft carriers.

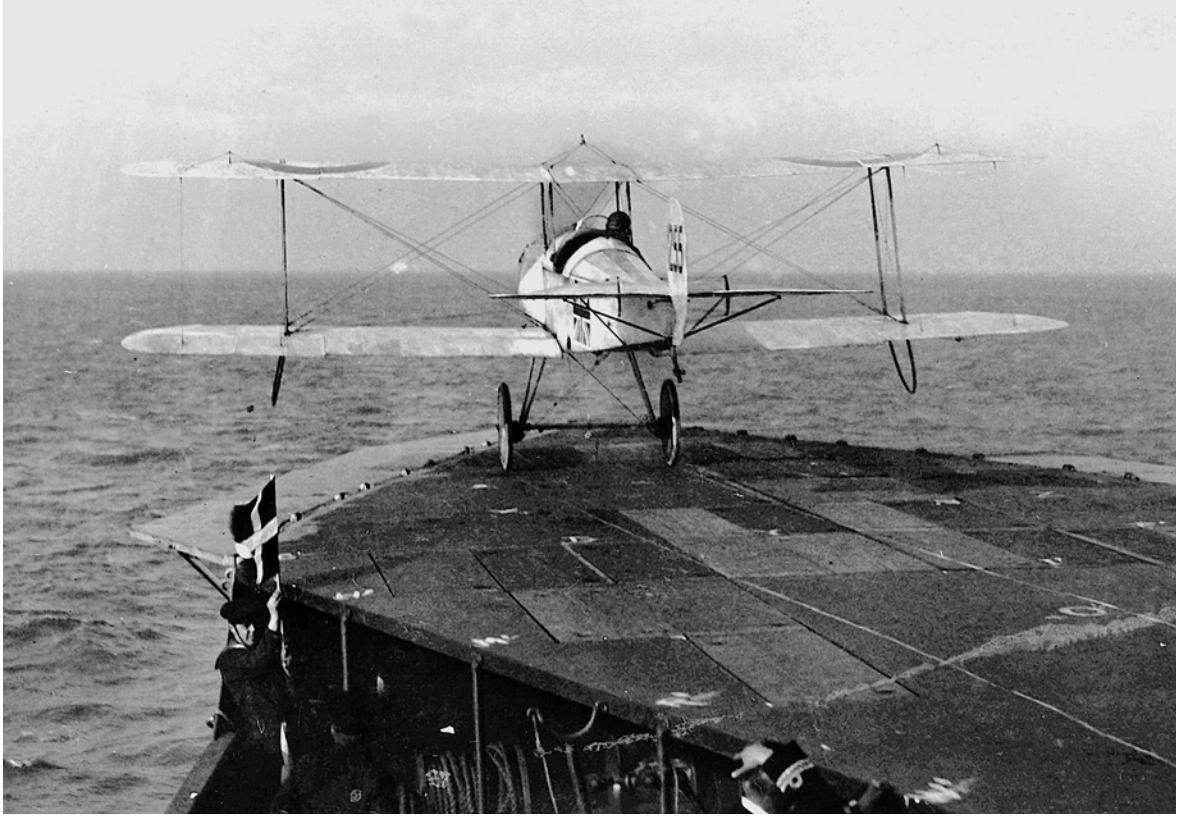
However, that the new *Ark Royal* appeared at all was an accomplishment, for within the higher command levels of the Royal Navy there was an overt lack of faith in the latest Hawker single-seat Nimrod and two-seat Osprey carrier biplane fighters. This was very apparent when, in 1936, the entire contingent of fighters from *Furious* was

disembarked, while two years later, during the Munich Crisis, just two were left on board *Courageous*.

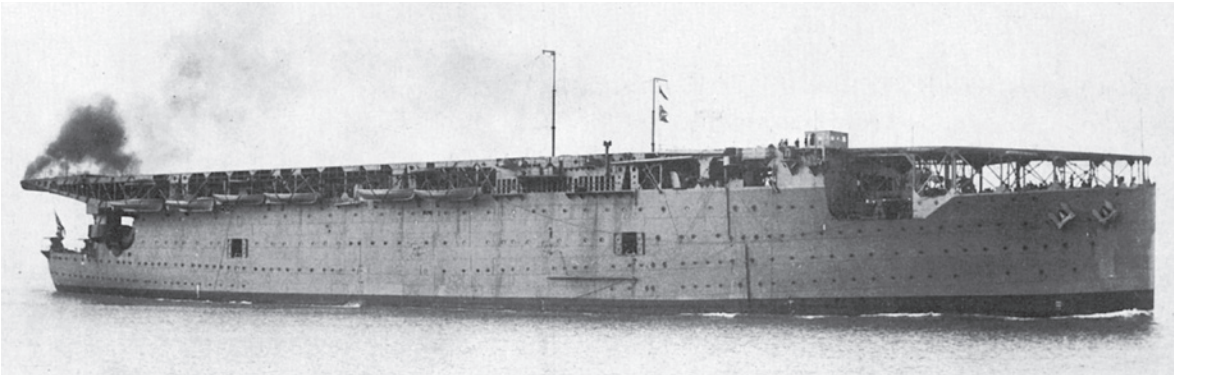
Despite any 'carrier antipathy', however, in 1936 the Admiralty issued a new building programme which included the construction of a further two aircraft carriers. It was fortunate that the Third Sea Lord, Adm Sir Reginald Henderson, who also happened to be a former commander of *Furious* and Rear Admiral, Aircraft Carriers, recognised that in a future conflict, the main threat posed to the new carriers would be from land-based aircraft, the more recent designs for which incorporated ever-greater ranges. The carriers would be fast enough to evade enemy surface vessels and increased escorts would protect them from submarines, but the air threat was less manageable, especially in the North Sea and Mediterranean.

As a solution, Henderson proposed the incorporation of significant armour protection, with flightdecks able to withstand a direct hit from a 500lb (225kg) bomb from above 7,000ft or 1,000-lb (450kg) bombs dropped from below 4,500ft. Importantly, the vessels had to be able to remain operational even after sustaining damage. The daunting task of designing these new reinforced 23,000-ton warships became the responsibility of William A. D. Forbes, the Royal Navy's chief carrier designer who had not long completed work on *Ark Royal*.

It was a long path to the commissioning of a new carrier by the Deputy Director of Naval Contracts. The need for such a vessel first appeared 'officially' in requirements



On a calm sea on 3 November 1915, the Royal Navy's Flt Lt H. F. Towler, flying Bristol Scout C No. 1255, made the first take-off from a carrier ship in wartime when he successfully left the deck of HMS *Vindex*, a small seaplane carrier used for operations against German Zeppelin airships. (Robert Forsyth)



The low, grey shape of *Argus* provides a glimpse of the future of the aircraft carrier. The first deck landing on the ship was made on 24 September 1918 using a Sopwith 1½ Strutter flown by Cdr R. Bell Davies. Converted from a passenger ship hull during World War I, *Argus* was being used as a training carrier by 1939. It later took part in Operation *Torch*, when it had Seafires of 880 NAS embarked. (Angus Konstam)

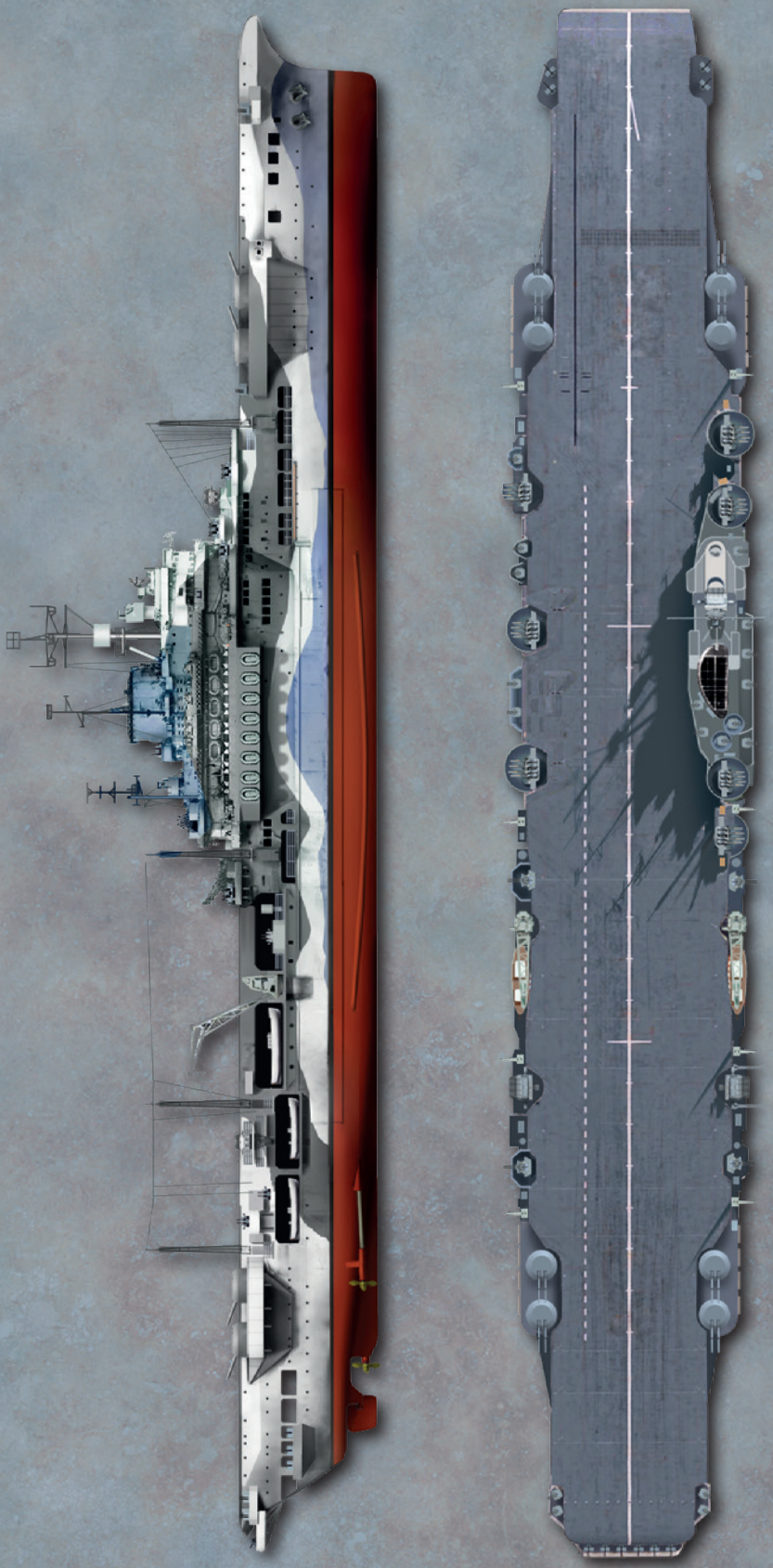
set out by the Admiralty Board that contained details on restrictions and alternatives, methods of propulsion, the complement and type of aircraft to be carried, and intentions regarding armament. This was followed by a series of sketches that were often revised as financial aspects were taken into consideration, as well as changes in equipment and aircraft availability and specifications. These sketches frequently met with resistance or rejection from the Naval Staff and subsequently resulted in delay when a designer had to go back to the drawing board, while at the same time having to take into consideration what was practical and achievable, regardless of what the Naval Staff felt.

The design of an aircraft carrier represented a workable balance of speed, protection and aircraft capacity – along with compromise. Eventually – and it could be a tortuous process – fundamental agreement was reached on size, design and weight. When it came to the Illustrious-class, Forbes had to conduct considerable revision to the specifications of the innovative 'armoured box' concept.

The next stage was to draw out the design-and-build for a flightdeck on which the embarked aircraft could operate efficiently, as well as the requirement for flightdeck equipment, bomb and lifts, internal hangar space and storage. Sketches, plans, drawings, calculations and costings were poured over and checked again and again. Revisions and corrections were made. Once the Naval Staff was satisfied that the plans represented something viable and strategically justifiable, they were put before the Admiralty Board. If approval was given, then new plans would be issued covering armour, machinery, hydraulics and electrics which, hopefully, would not attract too much meddling from the government. The contracted shipbuilder, such as Vickers-Armstrong at Barrow, Swan Hunter on Tyneside or Cammell Laird at Birkenhead, as well as the main machinery contractor, would have a major input to the design, while various naval departments would supply specialist experience and knowledge and interpret the Admiralty's requirements.

The new carriers commissioned in 1936 would be known as the Illustrious-class and would be notable for the inclusion of an 'armoured box' in which was housed a single hangar that could accommodate 36 aircraft, versus *Ark Royal*'s 60 which were housed in two hangars. This was the compromise of armour and weight over speed and capacity.

Along the top of the box, which extended the entire length of the vessel with armour of 4½in., was the flightdeck, protected by armour 3in. thick. Fore and aft



HMS *Indomitable* wore a disruptive camouflage scheme at the time of Operation *Pedestal* in August 1942. Its decks and hull were in dark grey, over which was applied a white wavy line, while darkish areas of blue grey were applied to the superstructure and lower hull. The pattern was intended to enhance concealment, while disruption would hinder identification at medium ranges.

were armoured bulkheads that were also 4½in. thick. The box was mated with the armoured belt that protected the carrier's propulsion system, fuel tanks and magazines. The hangar measured 456ft in length and was 62ft wide and 16ft high. It could, at a pinch, accommodate 30 Swordfish torpedo-bombers along with six fighters or dive-bombers.

The vulnerable areas in this concept were the two lifts, one located towards each end of the flightdeck. In order to function, these were not armoured, although armoured screens could be rolled into position to protect the hangar during action. Another drawback of this design was the fact that aircraft could not be run up inside the hangar without risk to personnel, and this also may well have had a negative effect on serviceability levels. In its favour, however, the armour gave far greater protection against the enemy and the weather, unlike the 'open' hangars of US Navy carriers. Furthermore, the 'closed' nature of British hangars helped firefighting procedures.

Forbes' plans for the Illustrious-class were approved by the Admiralty Board in December 1936 and the first ship, the class's namesake, was ordered on 13 January 1937 and was to be built at Vickers-Armstrong in Barrow – the lowest bidder in the tender process and the first carrier-build for that yard. Even then, more 'paperwork' for what became 'Yard No. 732' had to be undertaken. What were now considered to be the Admiralty's designs for *Illustrious* were sent to Vickers-Armstrong's Naval Architect Department, which assessed the overall design of the ship in respect to practicality of its construction, as well as the hydrostatic requirements for the location of the fuel tanks to ensure the vessel's stability.

Following further consultation, and agreement with the Admiralty, the Designing Office and Ship Drawing Office at Vickers-Armstrong set to work, respectively, on 'offsets' – the detailed lines of the hull – and the general arrangement drawings of the various elements of the hull. The latter included piping, ventilators, heaters, store rooms, magazines, bomb rooms, messing and sleeping quarters, rigging and life boats, hangars, aircraft equipment storage and provision for maintenance. The Ship Drawing Office would then liaise with 'The Loft', where full-scale plans were produced on that department's large floor areas. At the end of the drawing process, no fewer than 2,500 plans had been generated.

Finally, when the drawings were sent to the plate shops, *Illustrious* began to take on a physical shape. Both *Illustrious* and the second vessel, *Victorious*, being built at Vickers-Armstrong's other yard on Tyneside, were laid down in the spring of that year. Once the flat keel had been laid on *Illustrious*, the plates of the outer bottom were assembled, followed by the vertical keel and inner bottom, then the first watertight bulkheads. These were followed by steel side panels and plating, pillars, girders, more bulkheads, the development of main internal spaces and, eventually, the decking.

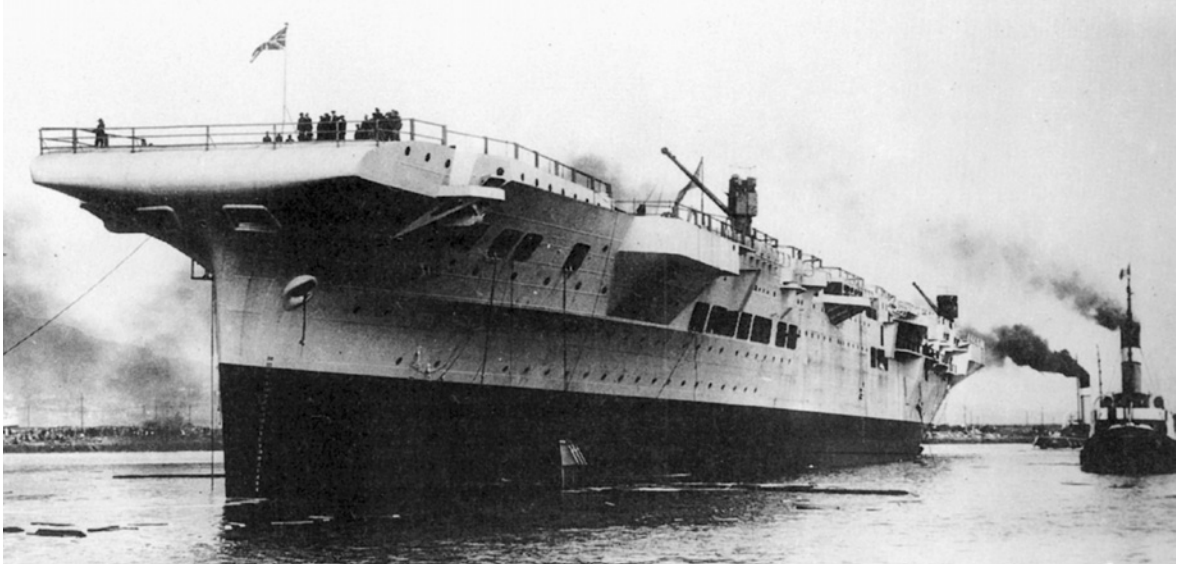
Forbes had achieved something quite remarkable in balancing the weight of an armoured deck with stability, but the construction of the ship was, at times, complex. The massive 4½in. bulkheads intended to form the sides of the hangar had been prefabricated elsewhere, and when they arrived at Barrow they proved impossible to lift and cut and so had to be levered up into place from the deck. Over these were laid massive beams, four feet deep, to hold the weight of the 3in. deck. There was also the 'inconvenience' of not being able to secure a long run of deck plating in order for it

to be removed after launch to allow installation of the ship's main machinery. Furthermore, sections of the flightdeck had also been prefabricated in Czechoslovakia, and they were late in arriving. When they did arrive – fortunately before the outbreak of war – two rectangular holes, fore and aft, had to be cut where the aircraft lifts were to be installed. Each lift was 45ft long and 22ft wide and weighed 14,000lb.

Finally, on 5 April 1939, Lady Henderson, wife of Rear Admiral, Aircraft Carriers, Sir Reginald Henderson, who was by this stage in ill-health, broke a bottle of champagne across the bows of *Illustrious* and the enormous vessel slid down into the waters of the Walney Channel. By the summer the ship had been towed to the fitting-out basin in Buccleuch Dock, where the loose deck plating was taken up. The dock's huge crane then lifted the carrier's six Admiralty three-drum boilers and three 111,000hp(S) three-shaft Parsons geared turbines and lowered them in place, after which the plates were laid back down, secured and riveted. The turbines would be able to deliver 30 knots. The vessel's bridge island and tower were built with the aid of a seven-ton steam crane that moved along railway tracks laid down on the flightdeck, and these were followed by the funnel, masts and conning platforms. Officially, the ship's complement was listed at 1,229.

For armament, *Illustrious* would carry an eight-gun battery of a new design of 4.5in. combined high- and low-angle guns in turrets (unlike the open mountings in *Ark Royal*), with two located on sponsons on each quarter of the flightdeck. These were to be augmented by six new type eight-barrel, multiple two-pounder pom-pom high-velocity anti-aircraft guns, known also as 'Chicago pianos'. These were planned to be mounted, in a similar configuration to *Ark Royal*, on the port side or fore and aft of the island, but at this stage little was known about these guns. In fact, little would be known until the arrival of specialist gunnery officers.

Illustrious was the first such vessel in the world to be fitted with radar, which comprised a Type 79Z set that was able to pick up an aircraft flying towards the carrier at 10,000ft at a distance of 52 nautical miles, with an aircraft at an altitude of 20,000 ft



Formidable was launched at the Harland & Wolff yard in Belfast on 17 August 1939. The partially complete vessel is seen here under the control of tugs following what was a premature and hazardous event. The ship broke free of its cradle, causing heavy timber balks to collapse and the hull to list. The wife of a shipyard worker was killed and 20 workmen and spectators were injured. *Formidable* would remain in service until 1946. (Angus Konstam)

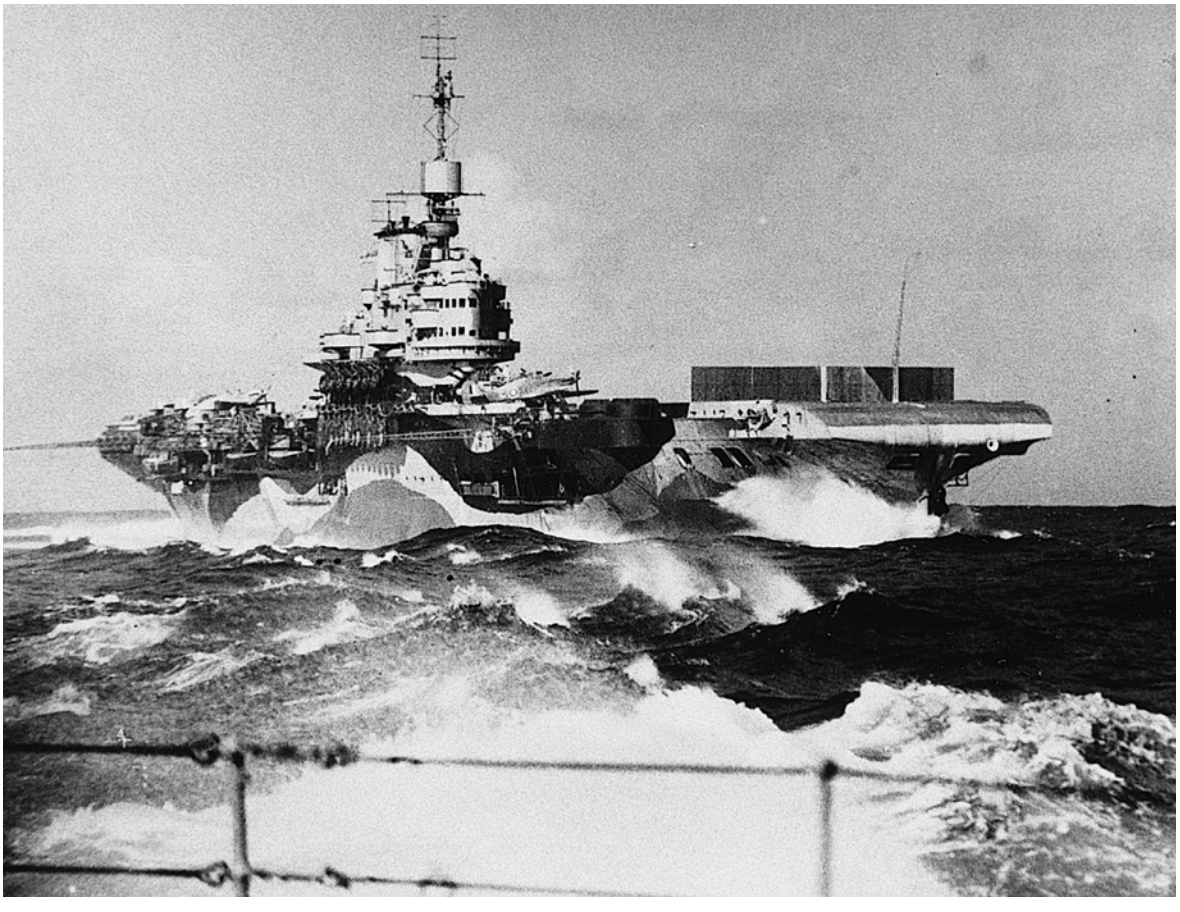
being detected at about 90 nautical miles. Later, Type 281 air warning radar was installed, supported by a Type 277 height-finding set with a plan position indicator. The latter provided fire control for the anti-aircraft guns and air-search capability over a range of 25–35 nautical miles.

The flightdeck was fitted with a single BH-III hydraulic steam catapult located forward, port of the centreline, in a shallow structure. The catapult's sloping, faired sides allowed the wheels of aircraft to move over it without hindrance. Finally, there were arrestor wires laid across the after section of the flightdeck. An aircraft of 12,500lb could be launched at an end-speed of 66 knots. *Illustrious* was also the first carrier to be fitted with a 'Jumbo' – a 6.75-ton, mobile, petrol-electric crane on the flightdeck that was able to lift 5,000lb.

On 17 August 1939, as *Illustrious* was brought to readiness, the second ship in the class, *Formidable*, was launched by Lady Kingsley Wood at the Harland & Wolff yard in Belfast – the wife of the Air Minister was forced to act quickly with the champagne bottle when the carrier had started to roll down the slipway of its own accord 30 minutes ahead of schedule. Unfortunately, the wife of a shipyard worker lost her life and several men were injured, but *Formidable* was undamaged. The carrier was followed by *Victorious*, which had suffered delays mainly due to scant deliveries of armour-plate, on 14 September at Tyneside, the champagne bottle being shattered by Lady Augusta Inskip, wife of the Minister of Defence Coordination.

A fourth Illustrious-class carrier, *Indomitable*, had been laid down at Barrow on 10 November 1937, and it was launched on 26 March 1940. Of major significance, however, was the request by the Admiralty that a larger air contingent had to be carried on this final vessel in the class. Thus, *Indomitable* incorporated a more lightly armoured box, its sides having been reduced to 1½in. and the belt armour to 3in., although the

Carrier power – *Indomitable* (furthest), *Victorious* and the light fleet carrier *Eagle* (nearest), photographed from the air while operating with the Mediterranean Fleet at the time of Operation *Pedestal* in August 1942. After *Pedestal*, *Victorious* saw action against *Tirpitz* in northern Norway and with the Eastern Fleet against Japanese targets in Burma and the East Indies. It was later struck by kamikaze aircraft off Okinawa but survived. *Eagle* would meet its end during *Pedestal* when the carrier was torpedoed by U-73 in the Mediterranean between Mallorca and Algiers. It sank in just minutes with the loss of 160 crew. (Angus Konstam)



Indomitable, seen here in a disruptive scheme, ploughs its way through a Mediterranean swell with wind screens up and Sea Hurricanes tied down to the flightdeck either side of the island during *Pedestal*. (Andrew Thomas Collection)

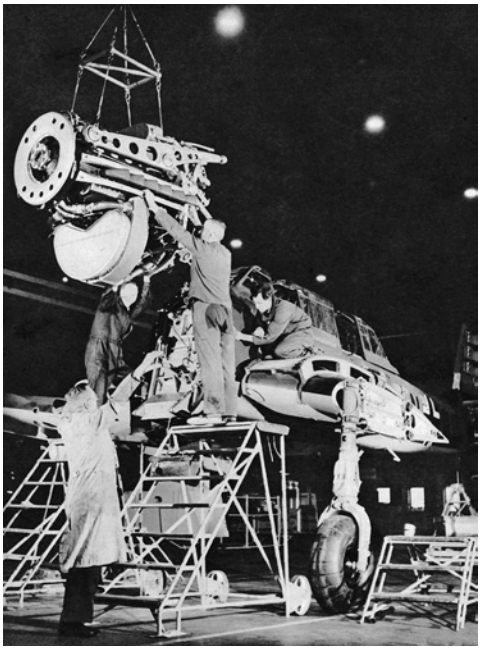
thickness of the flightdeck remained unchanged. These modifications enabled the carrier to accommodate 45 aircraft – nine more than the other vessels in the class. Furthermore, the alterations allowed the height of the flightdeck to be increased by 14ft, which meant a second hangar deck could be introduced, although two decks meant an overall reduction in height to each compared to the other three carriers in the class. Additionally, workshops and accommodation were installed to cater for a larger air group. This basic arrangement also featured in the later Implacable-class carriers HMS *Implacable* and HMS *Indefatigable*, which were launched in December 1942.

Chronologically, the carriers would be commissioned as follows – *Illustrious* on 25 May 1940, *Formidable* on 24 November 1940, *Victorious* on 29 March 1941 and *Indomitable* on 10 October 1941.

After completion, *Illustrious* went to Bermuda to take on three units: 806 Naval Air Squadron (NAS) with the first Fulmar eight-gun fighters in fleet service, and 815 and 819 NASs with Swordfish. It then departed for Scapa Flow, where the carrier remained briefly before sailing in August to the Mediterranean Fleet, flying the flag for the Rear Admiral, Aircraft Carriers Mediterranean, Rear Admiral Lumley Lyster. Within six months the ship's crew would be tested against a deadly and determined adversary in the waters off North Africa in the form of the Luftwaffe's Ju 87s.

TECHNICAL SPECIFICATIONS

A Jumo 211 engine unit, complete with radiator and attachment points for propeller and spinner, is hoisted over the factory floor at Dessau ready for fitment to the firewall of a Ju 87B. The outer port wing has yet to be fitted, but the starboard wing appears to be in place or about to be attached. Junkers had built 187 B-series aircraft by the end of March 1939, and the following month RLM production plans called for 964 machines by July 1940. (EN Archive)



Ju 87B/R STUKA

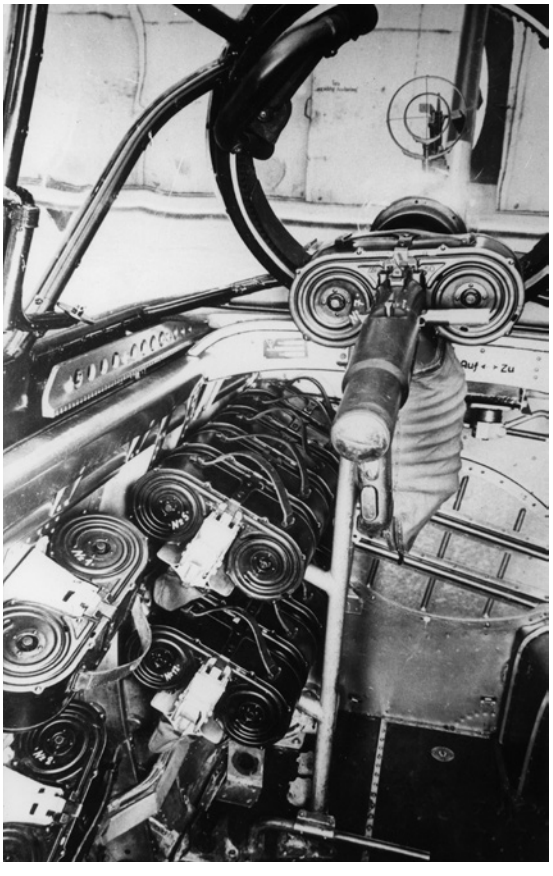
By the end of 1940, the Ju 87 had earned itself a reputation for being an outstanding weapon of *Blitzkrieg*. Indeed, its performance and effectiveness as a battlefield support aircraft was still to be felt in the Balkans and the Soviet Union, as well as in the Mediterranean and North Africa. During the German attack in the West in 1940, Ju 87s were called upon by ground units to attack specific targets in the enemy rear – troop and vehicle assemblies, fuel and ammunition stores, road nodal points and bridges – more so than rendering close air support *on* a battlefield. The speed of the German mechanised advance often made strikes for direct ground support purposeless.

However, truly effective deployment of the Stuka could only be assured in an environment where the Luftwaffe enjoyed air superiority. In the skies over the English Channel and southern England in the summer of 1940, the vulnerability of the relatively slow Ju 87 when, unescorted, it encountered enemy fighter opposition, was highlighted. Such was the occasion on 13 August when, from a force of 27 Ju 87s of Hauptmann

Walter Enneccerus' II./StG 2, five were lost to Spitfires while attempting to strike Middle Wallop airfield. A sixth went down in the Channel on the way home.

In terms of anti-shipping missions, during the evacuation of British forces from Dunkirk in May and June 1940, Ju 87 crews found that targeting faster, manoeuvrable warships was a more difficult task than bombing slower merchantmen. Nevertheless, despite adverse weather and RAF fighters that frequently intercepted the Stukas before they were able to reach the beaches, a large number of destroyers, passenger vessels and smaller merchant ships were sunk.

Results during operations by extended-range Ju 87R-1s of I./StG 1 against Royal Navy vessels evacuating Allied troops from Namsos and Aandalsnes in Norway also proved spectacular, even if the targets were misidentified. On 3 May hits were reported by 250kg bombs between the forward turrets of a 'battleship', which caused a 500m-high sheet of flame. In a second attack that same day the destroyer HMS *Afridi* went down with the loss of 63 lives. It was hit by two bombs, one passing through the wireless telegraphy office and exploding beside the No. 1 Boiler Room and the second hitting the port side just forward of the bridge and starting a severe fire at the after end of the mess deck. This may have been a destroyer and not the battlecruisers HMS *Hood* or HMS *Repulse* as the Stuka crews had believed, but the point had been proven that the Ju 87 *could* target and sink ships.



The cramped 'backseater's' position in a Ju 87B-2, with a standard defensive fitment of a 7.92mm Rheinmetall MG 15 machine gun and ring sight above. Note the cartridge bag below the gun. Ten spare drum magazines are seen in quick-release clip and bracket stowage positions against the fuselage wall. Note the large canopy handle and the tail unit visible through the canopy, with the slightly turned rudder bearing an early style Hakenkreuz. (EN Archive)

The two variants that would see action in the Mediterranean from early 1941 were the *'Berta'* (B) and the *'Richard'* (R). In the case of the B-2, the all-metal fuselage was built in two oval sections, mated at the side centre line and resulting in a semi-monocoque shape of forms and stringers. The Ju 87B-1 was powered by a 1,100hp 12-cylinder, liquid-cooled Jumo 211A engine driving a Junkers-Hamilton controllable-pitch hub with either three metal or compressed wooden propeller blades. The aircraft had a maximum speed of 370km/h at 4,500m and a cruising speed of 325km/h. It could climb to 990m in 120 seconds and had a ceiling of 8,000m, with a range of 800km. Unladen, it weighed 2,320kg, and laden, a maximum of 4,340kg.

For a single-engined, two-seat machine, it was not a small aircraft, possessing a span of 13.8m, length of 11m, height of 4.2m and a wing area of 31.9 sq m. The Ju 87B-2 had low set, cantilever wings that were built comprising three sections, of which the centre section was set at a coarse anhedral angle of 12 degrees from the fuselage sides.

Hydraulically operated radiator cooling gills were introduced on the Ju 87B-2, which was powered by a 1,200hp Jumo 211Da engine.

A fixed, forward-firing 7.9mm MG 17 machine gun was carried in each wing, installed so that it was outside the arc of the propeller. The forward barrel of each gun

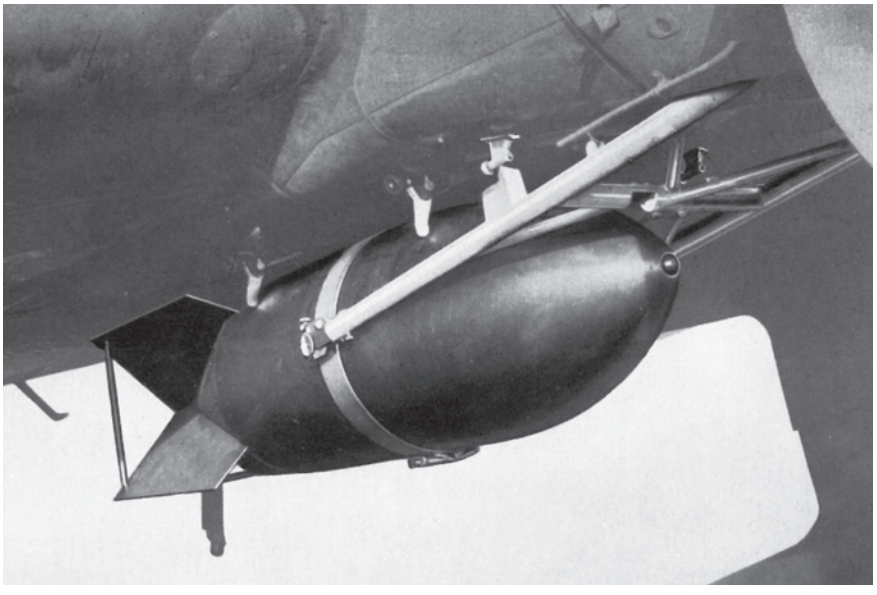
Ju 87B BOMB-RELEASE

Underside view of a Ju 87B loaded with a 500kg SC 500 bomb and the 'trapeze' bomb-release sling in the down position once the bomb has been released. The trapeze was intended to clear the weapon away from the arc of the propeller and any airflow around the aircraft.

1. Clevis
2. Pawl
3. Inner bolt
4. Traverse
5. Sleeve
6. Spring bolt
7. Traversing arm
8. Rubber buffer
9. Locking plate
10. Ball heads
11. Rope/cable holder

was encased in a ventilation tube where it protruded from the wing leading edge. A single 7.9mm MG 15 was mounted flexibly for the rear gunner.

A number of factory produced *Umrüst-Bausätze* (retrofit kits) were made and fitted, with a 'U' suffix to the variant. The B-1/2/U1 saw some minor modifications to the standard variant. The B-1/2/U2 had improved internal radio equipment. The B-1/2/U3 saw additional armour fitted beneath the engine and cockpit areas in 1941 following experience gained in operations over the Channel Front the previous year – this included an angled plate fitted either side of the rear gun mounting. The B-1/U4 was a machine intended for carrier trials.



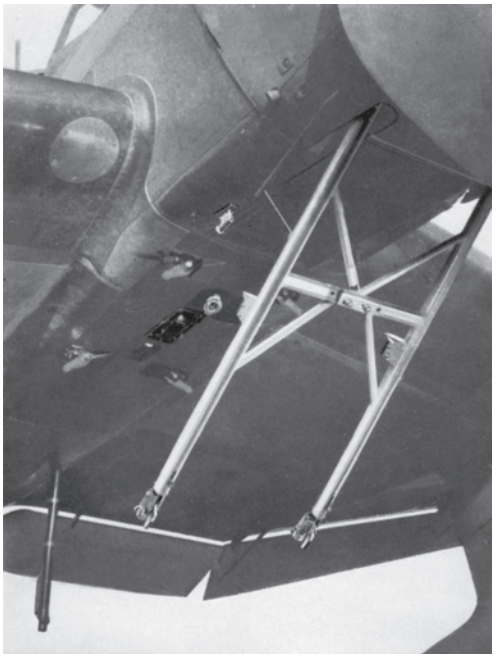
An SC 250 250kg bomb fitted to the under-fuselage attachment points, with the 'trapeze' deflector frame folded back to lock the bomb in place. Such a weapon contained 125-139kg explosive weight of either Trialen 105, Amatol 39, 40 or 41, or Ammonal D, J or DJ11. (EN Archive)

One 250kg bomb was the usual load for attacking thinner hulled merchant ships, while 500kg bombs could be used against cruisers and larger warships. A formation leader would waggle his wings, which was the signal for accompanying crews to prepare for their dives and for pilots to activate bombing instruments. Radiator flaps would be closed, the supercharger turned off and a dive lever pulled rearwards, limiting movement of the control column in order to prevent over-control and stress on the airframe, before the Ju 87 winged over. The pilot then set the angle of dive – usually 70–85 degrees, but often near vertical. The control column would be pushed forward and the aircraft nosed down.

The Ju 87 quickly accelerated and the pilot then applied the dive brakes, after which an automatic device took over and actuated the trim tabs. The dive brakes were 1.8m in length, with a width of 22.8cm, and when in a dive they rotated through 90 degrees so that their plated area was presented against the airflow. In normal flight they were retracted edge-on to the airflow. As the aircraft dived, the pilot made final corrections on the bombsight and used a series of red angle lines that were engraved on the canopy side panels in order to line up with the horizon. He then pressed a knob on the control column to release the bomb.

A 'trapeze' deflector frame/cradle was fitted into two small ports in the fuselage underside just behind the chin radiator vent by means of ball heads. The frame comprised two parallel tubes joined by truss arms and was adjustable in order to accommodate bombs of different diameters. A 250kg bomb was fastened to the frame as a standard load by means of clevis pins at the other ends of the two tubes and then secured to the underside of the fuselage. A 500kg bomb could be carried in the absence of a rear gunner. The bomb was dropped from the trapeze to clear the arc of the propeller. A 250kg load could be supplemented by a pair of 50kg bombs under each wing.

To pull out of the dive, the pilot moved the dive lever forward, which re-released the control column, retracted the dive brakes, reset the bomb release switches and



The 'trapeze' in the lowered position prior to a bomb being fitted, or as it would appear after release. The drop and forward motion of the deflector frame would ensure that a bomb cleared the arc of the propeller. (EN Archive)

re-opened the radiator flaps to prevent the Jumo engine from over-heating.

Yet despite the Ju 87's method of attack, delivery and accuracy proving generally successful in shorter-range operations, such attributes were worthless against shipping and longer distance targets without range. The R (*'Richard'*) series was produced in an attempt to enhance this shortcoming. Thus, the B-1 was modified to accommodate an additional 150-litre fuel tank in each wing as a supplement to the 240-litre self-sealing tanks in the wing roots. Additionally, the internal fuel transfer system was redesigned so that fuel could be drawn from two further external, jettisonable, 300-litre wing tanks suspended from wing racks. These would be filled five litres short of full capacity for safety purposes.

With its additional fuel load, the Ju 87R-1 enjoyed a range of 1,400km compared with the B-1's 550km. All this, however, came with a sacrifice of 250kg in offensive load. The successive R-2, which evolved from the B-2, had only the external tanks as a supplementary fuel source, and thus its range did not reach that of the R-1, being only 1,250km. This drawback was countered by improved radio equipment, including some machines with FuG 25 IFF and a *Peil Gerät* IV, which aided long-range, over-water navigation.

ROYAL NAVY SHIPBOARD ANTI-AIRCRAFT GUNS

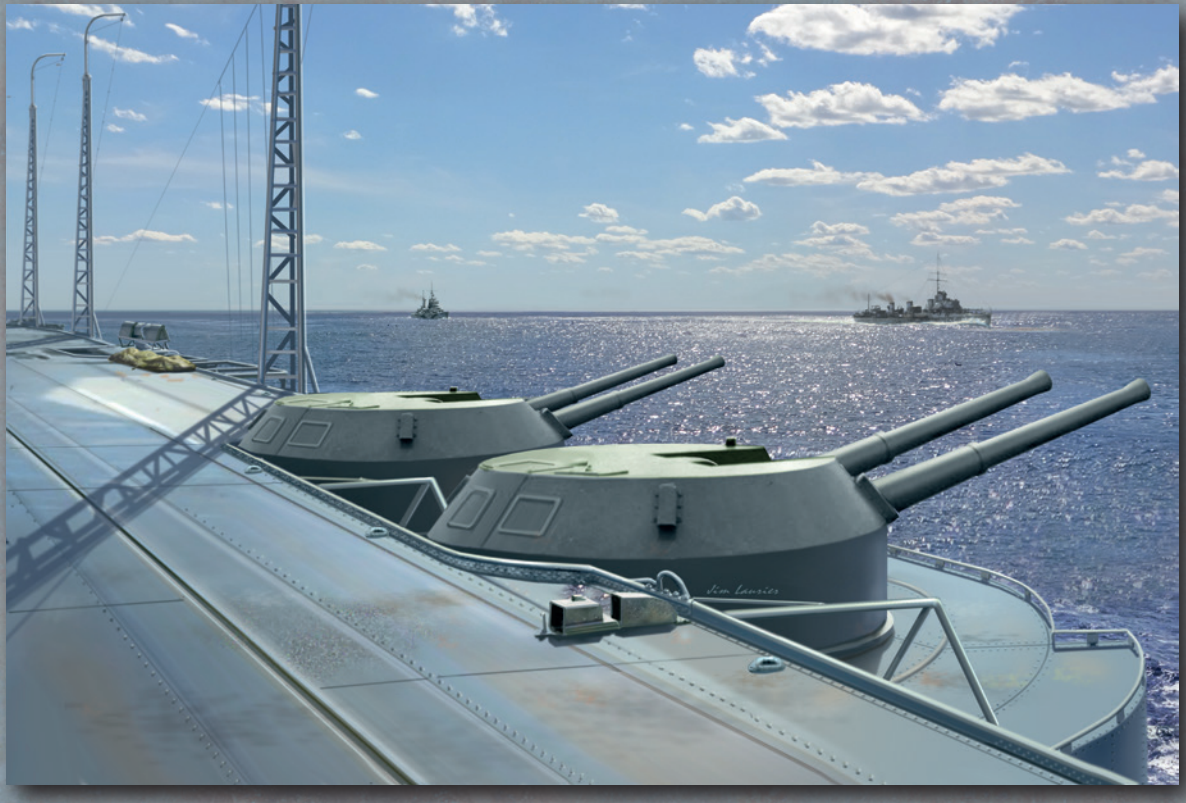
By mid-1940, with the threat of air attack against ships increasing exponentially as bombers and dive-bombers were introduced with greater range and bomb-loads, the Royal Navy's Director of Naval Ordnance was under pressure to provide an efficient, dual-purpose gun. To protect the vessels themselves and their precious complements of aircraft, the Illustrious-class carriers and the later *Indomitable* were completed with two main forms of anti-aircraft armament.

Each carrier was fitted with a battery of eight 4.5in. QF (Quick Firing) Mk III guns. These were housed in pairs in 37.95-ton BD (Between Deck) Mk II twin mountings in turrets on sponsons on each quarter of the flightdeck, grouped in pairs at port forward and aft, designated as the 'B' and 'Y' groups, and starboard forward and aft, designated as the 'A' and 'X' groups. The mountings were cramped and difficult to maintain, and had only a low shield above the weather deck, with the bulk of the mounting below it.

The guns were manufactured by the Royal Gun Factory at Woolwich and were developed from an army anti-aircraft weapon in order to allow use of the same fixed ammunition. The 4.5in. QF gun became the Royal Navy's standard, medium calibre weapon for use against surface, air and shore targets. Some 800 examples were built

4.5in. BD TURRETS

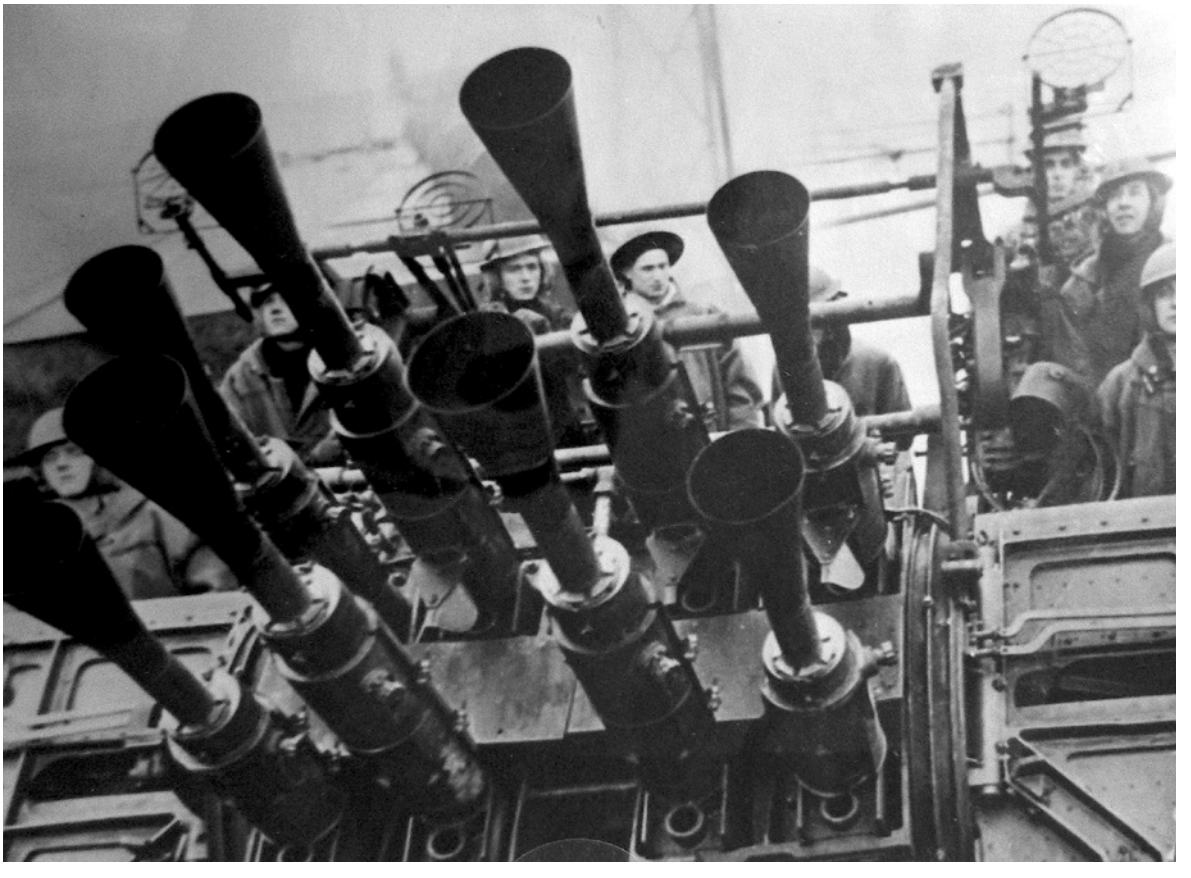
Unlike *Ark Royal*, which had open mountings, each of the Illustrious-class carriers were fitted with a battery of eight Vickers-built BD twin 4.5in. turrets, which had been designed and built before radar-guided aircraft interception techniques were available at a standard of operational readiness. The turrets were located in pairs on substantial sponsons, into which they were countersunk, forward and aft on the port and starboard sides. They were designated as 'A' and 'X' groups to starboard and 'B' and 'Y' to port. The turrets housed a pair of Royal Gun Factory 4.5in. Mk III medium-range guns, developed from an army anti-aircraft gun, on Mk II Dual Purpose mountings. The tops of the turrets stood 2ft 6in. proud of the deck to enable them to fire across the flightdeck, but this had the effect of interfering with aircraft movements. Not only that, but their installation, especially aft, also restricted aircraft ranging.



between 1939–41, with 474 going to the army, while for the Royal Navy, the 4.5in. QF gun was the only new weapon of its type to be introduced in wartime. It was initially intended for use on destroyers, but it was eventually taken up as a standard, fleet dual-purpose gun.

The Mk III gun was intended only for twin-mountings and was interchangeable. It weighed 6,304lb and was an improvement over the earlier 4.7in. gun. The latter was not effective as an anti-aircraft weapon, being restricted by the lack of a mounting to provide an elevation in excess of 55 degrees or a sufficiently sophisticated fire control system (the army gun, which did have an 85-degree mounting, was not considered suitable for deployment aboard a warship).

The problem was that 55 degrees was about the angle from which a dive-bomber attacked, so ideally a gun needed another 20 degrees of vertical deflection. For an



The last line of defence – one of the octuple two-pounder pom-poms on board *Illustrious*. The central foresight is the Trainer's, while at left and right are those of the Gunlayers. Also at far right above the ammunition container is the elevation receiver. (Robert Forsyth/ ADM267/83)

aircraft flying at right angles to the line of sight of a gun crew, the aim-off, or deflection, was nearly all Lateral Deflection. This was ahead of the aircraft and was calculated in the High Angle Calculating Position (HACP), before targeting data was sent to the training receivers at the guns. In the case of an aircraft approaching directly towards a ship, the aim-off or deflection was nearly all Vertical Deflection. Again, this was ahead of the aircraft and was calculated in the HACP, with data then being sent to the guns. The composition of an HACP is explained in The Combatants chapter.

Naval guns were loaded at the breech end. After the projectile and firing charge were inserted, the breech was closed by a breech block. Owing to the pressure set up in the chamber of the gun, when the charge was ignited there had to be a means of sealing the rear end of the gun, as well as a means of firing the charge. Both of these functions were performed by the breech mechanism, of which there were two types: Breech Loading and Quick Firing. QF guns were also loaded at the breech end, and their charges were made up in brass cylinders. The latter protected the charge from wet and damp, as well as from flash, which was a major benefit for smaller guns in exposed positions. The disadvantage was that the heavy brass cylinder had to be withdrawn from the gun after the round had been fired.

QF guns were made as either pure QF, whereby the breech mechanism had to be worked entirely by hand, or semi-automatic, where the breech opened and the empty brass cylinder ejected automatically after firing. Pushing in the next round closed the

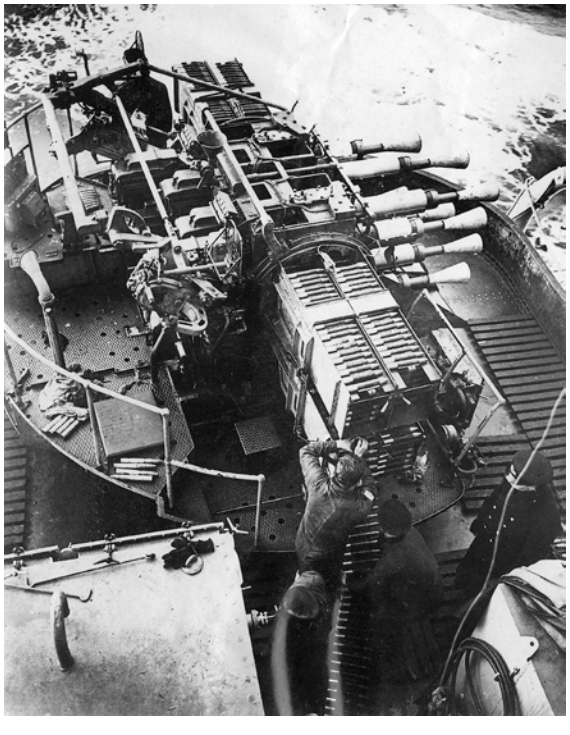
breech automatically. In the case of completely automatic guns, the new round was loaded into the gun automatically. The 4.5in. QF fired an 87lb high-explosive (HE) round, of which the projectile weight was 55lb – a heavier shell than the gun's 4.7in. predecessor. The approximate barrel life was 650 rounds.

The turrets for the 4.5in. guns, built by Vickers, were counter-sunk into the aforementioned sponsons. In compliance with an Admiralty directive that the guns should be able to fire across the flightdeck to the other beam, the tops of the turrets were 2ft 6in. proud of the deck, which, as they could not be positioned too far outboard, caused a narrowing of the flightdeck which duly limited the number of aircraft that could be operated. Their location also had an adverse effect on the movement of aircraft between flights. Each group of guns had its own Mk IV director that could guide its own weapons and/or any of the others on the ship.

From early operational experience, anti-aircraft gunnery procedure with High Angle (HA) guns tended to fire rounds 100 yards ahead of an approaching aircraft. It was recognised that this was way beyond what could be considered to be lethal range, but it would be near enough to the targeted aircraft to force its pilot to make an evasive movement, and so disrupt his aim. HA firing pointed guns at the enemy in the same way as low-angle (LA) firing, inasmuch as the weapons were kept aimed at the enemy, regardless of the ship rolling or altering course, by the HA Director tracking the aircraft and sending electrical movements to red pointers at the elevation and training receivers at the HA guns.

For close-range anti-aircraft gunnery, Illustrious-class carriers were equipped with two-pounder multiple pom-poms. Manufactured by Vickers, each carrier fielded six eight-barrelled (octuple) versions on Mk VIII mountings that were designated S(Starboard).1, S.2, S.3 and S.4, and P(Port).1 and P.2. The pom-poms were intended for use against low-flying or diving aircraft moving at very high speeds and at close ranges of 3,000 yards or less. Thus, the time in which such an enemy aircraft was in range was very short, and it was important for the control of these guns to be simple and, if possible, under the direction of one man. The guns were designed to fire rapidly, and had a higher muzzle velocity. They were also capable of being swung quickly when following an aircraft or picking up a newly spotted attacker.

In the early years of the war, pom-pom gunners had to rely on 'eyeshooting', in which the aiming was judged simply by eye and without any calculating instruments to aid in where to point a gun so as to hit a moving target. As the Admiralty *Gunnery Pocket Book* of 1945 eloquently described it, 'the mode of operation is similar say, to throwing a boot at a cat running along the top of a wall. To allow for movement of the target during the time of the flight of the bullet, the gun has to be pointed ahead of the target at some position along its future path'.



An eight-gun set of two-pounder pom-poms on an octuple mount is reloaded on board the cruiser HMAS *Shropshire* during a bombardment of enemy installations on Biak Island in May 1944. Such Mk VA or VIA mounts, as were used on fleet carriers, weighed between 15 and 16 tons and had an elevation of -10/+80 degrees. (Argus Newspaper Collection of Photographs, State Library of Victoria)

The origin of the name 'pom-pom' came from the sound of the gun's firing, and lay in World War I when water-cooled 1½- and 2-pounder light machine cannon were mounted as a temporary measure on ships of the Grand Fleet and on cruisers based at Dover and Harwich. The recoil-operated guns proved unreliable and weak, but the need for such a weapon to deal with the threat of German remotely-controlled motor boats off the Belgian coast meant they remained in service, and ended up as the key naval anti-aircraft weapon. During World War I, pom-poms were manufactured under license in Italy as the 40mm/39, and in the inter-war years, such guns, often described as '40mm', were used by many nations including Japan, which fielded them in quantity. There is a suggestion that behind selection of the two-pounder shell for the Royal Navy was the fact that some 2,000,000 rounds of this calibre were left over from World War I.

In the 1920s, comparison trials had been carried out between two- and three-pounders to assess which was the smallest shell sufficiently capable of severely damaging or bringing down a torpedo-bomber with one hit. Both calibres proved capable of the task if the aircraft was hit in an engine, fuselage or inner wings. As such, the two-pounder was favoured.

In 1921–22, six two-pounder Mk II guns were mounted on board the light cruiser HMS *Dragon*, and the results of the trials were deemed successful. Based on this, the Vickers and Armstrong firms commenced work on a range of multiple-gun configurations. Armstrong produced a continuous-fire weapon, but it was more complex than the Vickers design, which lacked this capability. Vickers secured the contract, and in July 1923 produced an eight-gun mock-up at its Dartford factory. Sea trials on board the battlecruiser HMS *Tiger* did not take place until 1928 because of fiscal restrictions, but the gun entered service in 1930, with a single such mounting installed on board the battleship HMS *Valiant*.

For much of the 1930s, the two-pounder, recoil-operated pom-pom could be considered a state-of-the-art weapon, but by the end of the decade the advance in aircraft designs meant that it was virtually moribund. A higher velocity (HV) projectile was produced to go some way to countering this, but its adoption for service forced the Royal Navy to acquire a different breech mechanism and alter the pom-pom's firing gear. Furthermore, the newer HV guns, weighing 850lb (excluding cooling water), and the original low velocity (LV) units, weighing 572lb (excluding cooling water), were not interchangeable.

The approximate barrel life for LV guns was 5,000 rounds, and 7,200 rounds for HV weapons. Maximum range when firing LV rounds was 3,800 yards (effective at 1,200 yards), and 5,000 yards for HV rounds (effective at 1,700 yards). Ammunition was supplied in 14-round, steel-linked belts. For octuple mountings, shells were loaded into boxes holding 140 rounds per gun. Rounds were loaded onto feed rails, with the first and last round of each belt resting on the rail being attached to the next belt by connecting links. The remainder of the belt hung in a bight.

In its initial form, the firing gear on both quadruple and octuple mountings was operated by a manually turned crank, but in 1939 octuple mountings as installed on Illustrious-class carriers allowed fully automatic firing.

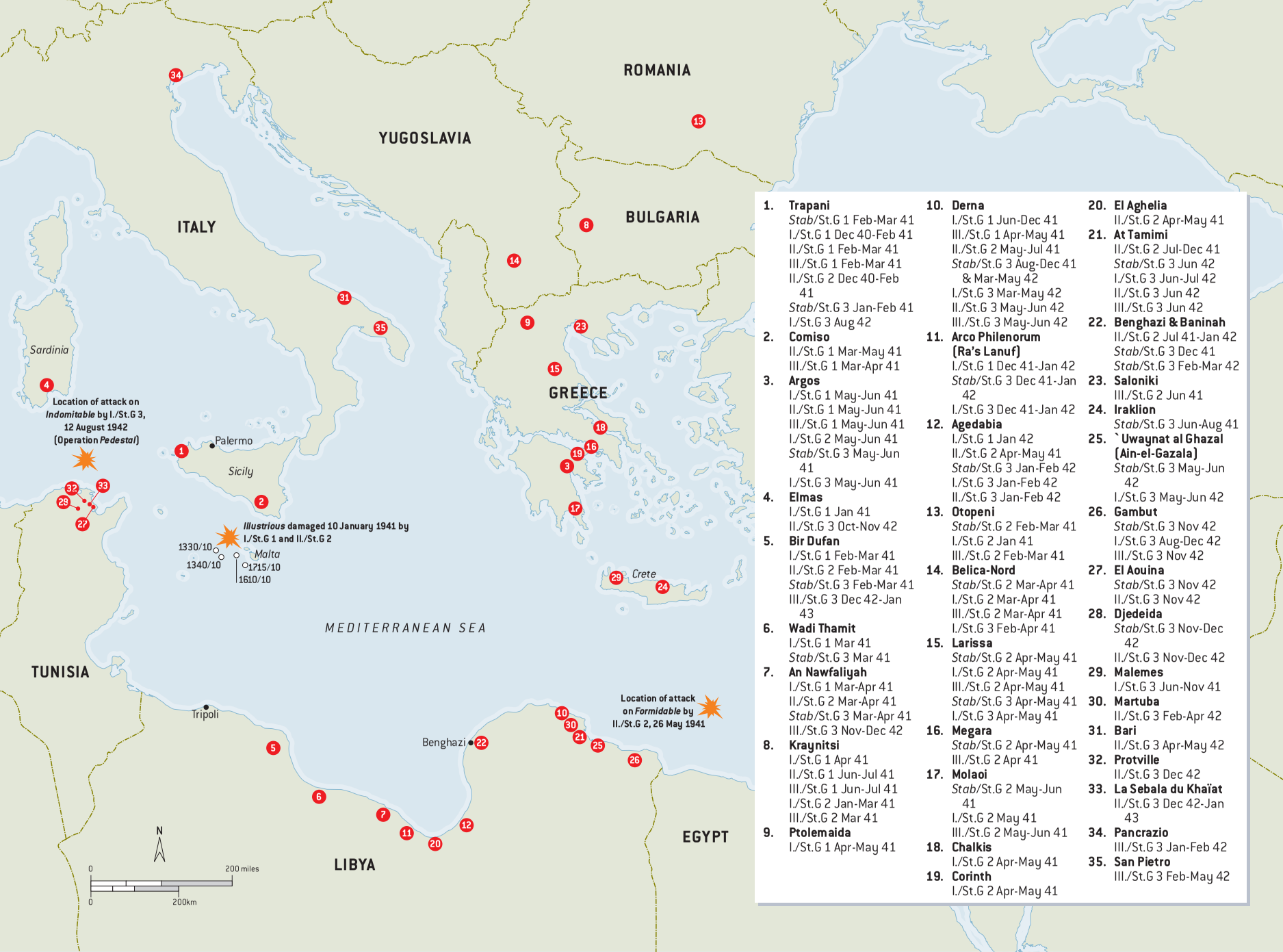
In octuple mountings, which weighed between 15 and 16 tons, the right- and left-hand outer and inner guns required different designs, and were suffixed as RHO, LHO, RHI and LHI. Elevation was -10/+80 degrees.

THE STRATEGIC SITUATION

In mid-September 1940 the Luftwaffe remained committed to bringing about a victorious end to the *Kanalkampff* – its campaign fought across the English Channel against the British Isles, thus paving the way for an invasion of southern England in accordance with German strategic aims and ambitions. In this, however, the Luftwaffe was faltering, unable to win air superiority over England and finish off RAF Fighter Command.

On 17 September, some 3,500 nautical miles from the English Channel, Italian forces under Marshal Rodolfo Graziani launched an advance from the Italian colony of Cyrenaica in Libya across the border with Egypt to reach Sidi Barrani, a town 90km to the east, close to the Mediterranean coast. Mussolini had vowed that his troops would advance the day the first German soldiers set foot in England. Conscious of a threat from the Italians, however, the British had pulled in reinforcements to Egypt from home and Australia, and by November 1940, Italian ambitions in Egypt began to unravel. The British and Australians repelled Graziani's divisions, pushing them back and collecting 20,000 prisoners along the way. In January 1941, things got worse for the Italians when the port of Bardia in eastern Libya, close to the Egyptian border, fell, with a further 30,000 troops captured. Not only this, but Italian forces had also become bogged down in Greece – a situation exacerbated with the arrival of Allied forces in Greece and Crete. The whole Italian position in the Mediterranean had become precarious, and Mussolini turned to his Axis partner, Adolf Hitler, to request military assistance in the area.

The problem was Malta. The British island colony in its central position in the Mediterranean between Sicily, 95km to the north, and the Tunisian and Libyan



1. **Trapani**
   Stab/St.G 1 Feb-Mar 41
   I./St.G 1 Dec 40-Feb 41
   II./St.G 1 Feb-Mar 41
   III./St.G 1 Feb-Mar 41
   II./St.G 2 Dec 40-Feb 41
   Stab/St.G 3 Jan-Feb 41
   I./St.G 3 Aug 42
2. **Comiso**
   II./St.G 1 Mar-May 41
   III./St.G 1 Mar-Apr 41
3. **Argos**
   I./St.G 1 May-Jun 41
   II./St.G 1 May-Jun 41
   III./St.G 1 May-Jun 41
   I./St.G 2 May-Jun 41
   Stab/St.G 3 May-Jun 41
   I./St.G 3 May-Jun 41
4. **Elmas**
   I./St.G 1 Jan 41
   II./St.G 3 Oct-Nov 42
5. **Bir Dufan**
   I./St.G 1 Feb-Mar 41
   II./St.G 2 Feb-Mar 41
   Stab/St.G 3 Feb-Mar 41
   III./St.G 3 Dec 42-Jan 43
6. **Wadi Thamit**
   I./St.G 1 Mar 41
   Stab/St.G 3 Mar 41
7. **An Nawfaliyah**
   I./St.G 1 Mar-Apr 41
   II./St.G 2 Mar-Apr 41
   Stab/St.G 3 Mar-Apr 41
   III./St.G 3 Nov-Dec 42
8. **Kraynitsi**
   I./St.G 1 Apr 41
   II./St.G 1 Jun-Jul 41
   III./St.G 1 Jun-Jul 41
   I./St.G 2 Jan-Mar 41
   III./St.G 2 Mar 41
9. **Ptolemaida**
   I./St.G 1 Apr-May 41
10. **Derna**
    I./St.G 1 Jun-Dec 41
    III./St.G 1 Apr-May 41
    II./St.G 2 May-Jul 41
    Stab/St.G 3 Aug-Dec 41 & Mar-May 42
    I./St.G 3 Mar-May 42
    II./St.G 3 May-Jun 42
    III./St.G 3 May-Jun 42
11. **Arco Philenorum (Ra's Lanuf)**
    I./St.G 1 Dec 41-Jan 42
    Stab/St.G 3 Dec 41-Jan 42
    I./St.G 3 Dec 41-Jan 42
12. **Agedabia**
    I./St.G 1 Jan 42
    II./St.G 2 Apr-May 41
    Stab/St.G 3 Jan-Feb 42
    I./St.G 3 Jan-Feb 42
    II./St.G 3 Jan-Feb 42
13. **Otopeni**
    Stab/St.G 2 Feb-Mar 41
    I./St.G 2 Jan 41
    III./St.G 2 Feb-Mar 41
14. **Belica-Nord**
    Stab/St.G 2 Mar-Apr 41
    I./St.G 2 Mar-Apr 41
    III./St.G 2 Mar-Apr 41
    I./St.G 3 Feb-Apr 41
15. **Larissa**
    Stab/St.G 2 Apr-May 41
    I./St.G 2 Apr-May 41
    III./St.G 2 Apr-May 41
    Stab/St.G 3 Apr-May 41
    I./St.G 3 Apr-May 41
16. **Megara**
    Stab/St.G 2 Apr-May 41
    III./St.G 2 Apr 41
17. **Molaoi**
    Stab/St.G 2 May-Jun 41
    I./St.G 2 May 41
    III./St.G 2 May-Jun 41
18. **Chalkis**
    I./St.G 2 Apr-May 41
19. **Corinth**
    I./St.G 2 Apr-May 41
20. **El Aghelia**
    II./St.G 2 Apr-May 41
21. **At Tamimi**
    II./St.G 2 Jul-Dec 41
    Stab/St.G 3 Jun 42
    I./St.G 3 Jun-Jul 42
    II./St.G 3 Jun 42
    III./St.G 3 Jun 42
22. **Benghazi & Baninah**
    II./St.G 2 Jul 41-Jan 42
    Stab/St.G 3 Dec 41
    Stab/St.G 3 Feb-Mar 42
23. **Saloniki**
    III./St.G 2 Jun 41
24. **Iraklion**
    Stab/St.G 3 Jun-Aug 41
25. **`Uwaynat al Ghazal (Ain-el-Gazala)**
    Stab/St.G 3 May-Jun 42
    I./St.G 3 May-Jun 42
26. **Gambut**
    Stab/St.G 3 Nov 42
    I./St.G 3 Aug-Dec 42
    III./St.G 3 Nov 42
27. **El Aouina**
    Stab/St.G 3 Nov 42
    II./St.G 3 Nov 42
28. **Djedeida**
    Stab/St.G 3 Nov-Dec 42
    II./St.G 3 Nov-Dec 42
29. **Malemes**
    I./St.G 3 Jun-Nov 41
30. **Martuba**
    II./St.G 3 Feb-Apr 42
31. **Bari**
    II./St.G 3 Apr-May 42
32. **Protville**
    II./St.G 3 Dec 42
33. **La Sebala du Khaïat**
    II./St.G 3 Dec 42-Jan 43
34. **Pancrazio**
    III./St.G 3 Jan-Feb 42
35. **San Pietro**
    III./St.G 3 Feb-May 42

coasts, had a civilian population of 270,000 as well as, crucially, several airfields and the only British harbour between Gibraltar and Alexandria. It was therefore ideally located as a base from which to interdict Axis convoys supplying the Western Desert, but lying more than 1,000 nautical miles from the nearest British port meant that it was difficult to supply. Nevertheless, Malta was to become a painful thorn in the Axis side.

The island had first been targeted by Italian aircraft on 11 June 1940, but the air defences had stubbornly rebutted the attackers on that occasion, as well as all their subsequent efforts. The British had maintained a somewhat fragile naval presence in the region under the command of acting Adm Andrew Cunningham, who had been Commander-in-Chief Mediterranean Fleet since June 1939, when he had replaced the freshly appointed First Sea Lord and Admiral of the Fleet Sir Dudley Pound. Cunningham's overriding priority was to protect British convoys as they plied the 3,500-mile stretch of the Mediterranean from Gibraltar to Egypt and the Middle East. En route, they ran the risk of being attacked by aircraft from Italian airfields on Sardinia and Sicily, in the south of Italy and along the coast of North Africa. And Cunningham had to repel such attacks with a relatively handicapped fleet of ageing warships.

Although it represented the greatest naval strength outside British waters, and had been reinforced by ships from the Home Fleet in May 1940, the Mediterranean Fleet, based in Alexandria by virtue of the Anglo-Egyptian Treaty of 1936, commenced hostilities with no long-range aircraft, no land-based fighter cover and almost no carrier aviation. Before the German invasion of France, there was a tacit assumption that the Mediterranean was France's jurisdiction, while British warships had fought to maintain control over the North Sea and interdict Germany's attack on Norway. But the events of May 1940 in the West changed everything.

Furthermore, the Italian attacks on the naval base at Malta had had an impact, and Egypt lacked any significant naval facilities. But on 11 November 1940, Cunningham struck back with audacity when 21 Swordfish from four squadrons were launched in two waves at night, an hour apart, from the new carrier *Illustrious*, which had joined the Mediterranean Fleet in September. The target was ships in the southern Italian naval base of Taranto, and Cunningham's initiative would demonstrate that a surprise raid by aircraft flying a distance of 160 nautical miles from their carrier could sink battleships in shallow harbour waters.

With crews using flares dropped from supporting aircraft in order to illuminate the targets, the 18in., 1,550lb Mk XII torpedoes carried by the Swordfish were set to work in a depth of less than 42ft. This also meant the attacking aircraft could exploit the fact that the Italian torpedo nets did not extend beyond the maximum draft of the battleships.

Illustrious photographed in 1941 with four Swordfish torpedo-bombers on its flightdeck. Also visible are the eight sets of twin 4.5in. quick-firing guns housed in Vickers-built turrets on sponsons located in pairs fore and aft. These weapons were supplemented by six eight-barrel two-pounder pom-poms, four to starboard and two to port. (Angus Konstam)

Despite intense anti-aircraft fire from shore batteries, the Fleet Air Arm biplanes launched their torpedoes from as low as 30ft above the water and crippled the new Italian battleship *Littorio*, as well as the older *Conte di Cavour* and *Caio Duilio*. A cruiser was also hit and the dockyard damaged – all for the loss of two Swordfish and a further two damaged. The next day, the Regia Marina relocated every seaworthy ship from Taranto to safer harbours along Italy's western coast, thus reducing the threat to British convoys. The surprise raid changed the balance of naval power in the Mediterranean in favour of the Allies.

Meanwhile, as the Italian presence in North Africa crumbled and British and Commonwealth land, sea and air forces consolidated their strength in various parts of the Mediterranean, Hitler, irked by what he considered to be his Italian ally's deplorably premature action against Greece, wrote to Mussolini on 20 November. The *Führer* lamented the fact that the situation in Greece and around the Mediterranean would have to be remedied, which, in turn, would mean diverting German forces to the region – forces which he had assigned for the planned invasion of the Soviet Union, although he did not choose to reveal that fact to *Il Duce*.

Hitler decided that a move through Bulgaria to Greece would be necessary, although with the onset of winter, that could not be done until March 1941. The *Führer* also hoped he could pull Spain into the war with the aim of blocking the western end of the Mediterranean. In the interim, however, it would be largely down to the Luftwaffe to prosecute vigorous attacks against the enemy's economic targets – such as convoys, ports and the Suez Canal – as well as, importantly, bombing the British Mediterranean Fleet, which would have to be destroyed in the three or four months leading up to German intervention in Greece. As such, he informed Mussolini that he would make available a *Geschwader* of bombers, plus the necessary reconnaissance aircraft and fighter cover.

In December, the *Generalinspekteur der Luftwaffe*, Generalfeldmarschall Erhard Milch, along with *General der Flieger* Generaloberst Hans Jeschonnek, Chief of the Luftwaffe General Staff, and Generalleutnant Karl Bodenschatz, Hitler's Luftwaffe adjutant, travelled to Italy to make arrangements for the transfer of units to the country. Hitler had told Milch he wanted such units returned to the Reich for other duties in early February, by which time he hoped that they would have inflicted significant damage to Britain's forces in the Mediterranean, especially its fleet.

Thus, towards Christmas 1940, X. *Fliegerkorps*, based in Norway and with headquarters in Oslo under *General der Flieger* Hans Geisler, was ordered to prepare to move south. This command, which in Norway enjoyed the status of a *Luftflotte* and, as such, reported directly to the RLM in Berlin, comprised 163 bombers drawn from *Stab*, II. and III./LG 1 (all Ju 88s), II./KG 26 and 2./KG 4 (all He 111s), the 34 Bf 110s of III./ZG 26, 11 Ju 88 reconnaissance machines of 1./(F) 121 and 31 Ju 52/3m transports of KGr.z.b.V. 9. X. *Fliegerkorps*' Stuka element consisted of I./StG 1 under Hauptmann Paul-Werner Hozzel and II./StG 2 under Major Walter Enneccerus, and their operations would be coordinated by *Stab*/StG 3 led by Oberstleutnant Georg Edert. A total of 78 Ju 87s were flown to Italy.

Many of X. *Fliegerkorps*' units and senior commanders had gained considerable experience in anti-shipping operations over the North Sea during 1940–41. Indeed, one of the Luftwaffe's earliest and most tactically acute anti-shipping experts, Oberst

Martin Harlinghausen, was its Chief of Staff. Geisler and Harlinghausen had studied the effects of dive-bombing attacks mounted against warships and concluded that with four well-aimed direct hits from bombs dropped by Ju 87s, even a carrier such as *Illustrious* with its 6,500 sq m flightdeck, could be sunk, regardless of its armour. So, while still in Norway, the crews of StG 2 embarked upon specialist training against a floating, mock carrier moored offshore. Results broadly supported Geisler's and Harlinghausen's theories.

In the Mediterranean, the principle objectives for X. *Fliegerkorps* were to neutralise Malta, by bombing, as a base for British air and naval forces, and thus secure the Axis supply route from Italy to North Africa; to interfere and ultimately stop the British supply route to Malta and Egypt from Gibraltar; and to support Axis forces in North Africa and to mine the Suez Canal.

In December 1940, the Luftwaffe transferred X. *Fliegerkorps* from Norway to the Mediterranean in order to bolster Axis air power in the region. With it came the Ju 87s of I./StG 1 and II./StG 2 whose operations would be overseen by *Stab*/StG 3. Operating from airfields in Sicily, the presence of the Stukas provided the Axis with a strong strike force, weighting the balance of air power temporarily in the Axis' favour. Here, a formation of Ju 87s, possibly from StG 2, is seen under fighter escort. (Robert Forsyth)

On 10 December Geisler received movement orders, and the columns containing the signals, Flak and transport units (the latter carrying equipment, bombs and fuel) of X. *Fliegerkorps* began to move south through Italy. As the year drew to a close, Hauptmann Hozzel recalled that I./StG 1 received brand new Ju 87R variants. 'To our surprise, the new Ju 87s were painted brown, the colour of desert sand. It called for little imagination to draw conclusions from this. We were obviously heading for the south, for new shores'.

By 26 December the bulk of I./StG 1 and II./StG 2 had reached Reggio Emilia and Forli, respectively, and on 2 January the first Ju 87 from *Stab*/StG 3 landed at Trapani in Sicily, followed over the coming days by another 80 dive-bombers from the assigned *Gruppen*. By 8 January 1941, 96 conventional bombers had also arrived on Sicilian airfields. They were joined two days later by 25 Bf 110s, and by the middle of the month, the figure had risen to 186 aircraft of all types.

The devastating performance of the Ju 87 in Poland, in the West and against shipping in the English Channel and the North Sea had instilled a form of blind faith within the Luftwaffe's highest levels of command in the Stuka's multi-targeting capabilities. It is therefore not surprising that when the Ju 87s of X. *Fliegerkorps* left Norway for the Mediterranean, Oberstleutnant Edert was told that *Illustrious* had to be sunk, and he passed the order on to the *Kommandeure* of his subordinate *Gruppen*.

By early January 1941, *Illustrious* was performing an essential role in the Mediterranean as the core of Force A – a covering force for three supply convoys transiting through the Mediterranean in Operation *Excess*, with Adm Cunningham as Commander-in-Chief of the operation from his flagship, the Jutland veteran battleship HMS *Valiant*. Force A was to cover the convoys east of the Skerki Banks in the Strait of Sicily. This area of relatively shallow, open sea was less than 180km from the Ju 87s' base at Trapani. The stage was set for a two-dimensional clash of arms between the fearsome, pinpoint accuracy of the Stuka dive-bomber and the formidable strength of the armoured aircraft carrier.

THE COMBATANTS

Ju 87 CREW TRAINING

In 1930s Germany, adolescent dreams of flying were given encouragement and guided by political and military overseers into reality. Aviation was a burgeoning and attractive proposition to young Germans of both sexes, who embraced the sport of gliding with an uninhibited fervour and zeal. When the Nazis came to power in January 1933, they made sure that such zeal was channelled and exploited as much as possible towards eventual military benefit.

Alongside learning to fly, boys and girls would be shown how to build model aircraft as well as real gliders, while simultaneously attending field-craft courses, physical fitness classes and workshop lessons that focused on aeronautical technology. Beyond that, throughout the 1930s an infrastructure of Luftwaffe *Flugzeugführerschulen* was established at which those who wished to – and who were considered good enough – could undertake elementary training in powered flight on a large scale for military service. Aspiring trainee pilots would qualify through a series of A, B and C certificates depending on a scale of aircraft weight classifications. Once qualified, a pilot, or observer, navigator, radio operator or air gunner would be assigned to a more advanced training school specialising in a given branch of aviation.

In mid-1936, personnel and equipment from I./StG 165, which had been formed at Kitzingen the previous year, were used to form an initial cadre – designated the *Sturzkampflehrgang Kitzingen* – to practise and develop dive-bomber and ground-attack tactics. A second cadre, known as the *Sturzkampflehrgang Barth*, was formed at Barth from IV.(Stuka)/LG 1 with support from Kitzingen-based instructors. In April 1939, both *Lehrgang* were combined to form a single Dive-Bomber Flying School, the

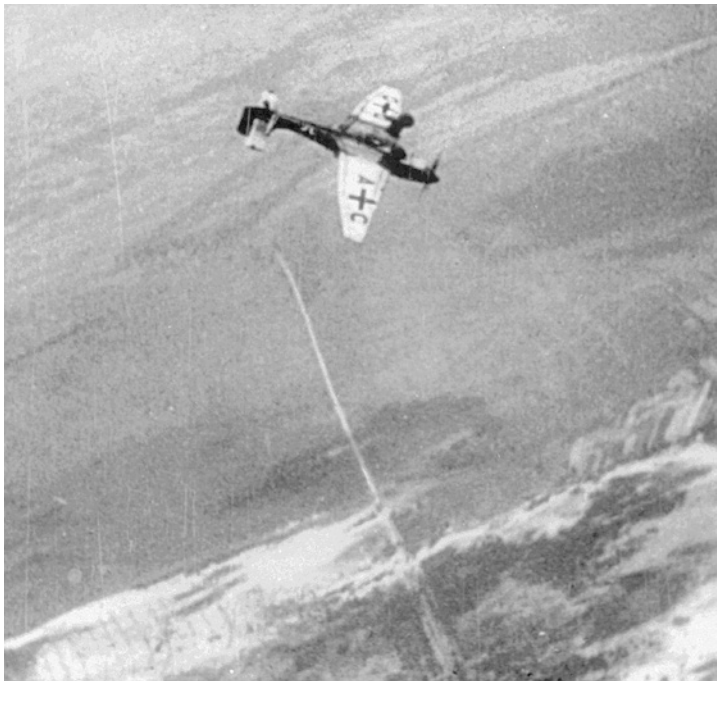
Sturzkampffliegerschule Kitzingen. This title was retained until 1 November 1939 when the school moved to Insterburg in East Prussia and was renamed as the *Sturzkampffliegerschule Insterburg*. The Staff of a second such school was formed in Otrokowitz in December and designated the *Sturzkampffliegerschule Otrokowitz*, although on 16 January 1940 it was renamed *Sturzkampffliegerschule* 2, with the Insterburg-based unit becoming *Sturzkampffliegerschule* 1.

The latter shared Insterburg with I./StG 160, which had been formed in the summer of 1938 with Hs 123 biplane ground-attack aircraft. By November, however, the *Gruppe* had not been assigned a *Kommandeur*, and so the *Kapitän* of 1. *Staffel*, Leutnant Werner Hozzel, was appointed to take over interim command at the time the *Gruppe* was due to convert to the Ju 87B, relocating from Silesia to Insterburg. Following their subsequent transfer, and having handed over their Henschels, the crews of I./StG 160 collected their new aircraft from a local air depot. Hozzel recalled his unit's early experiences with the Ju 87:

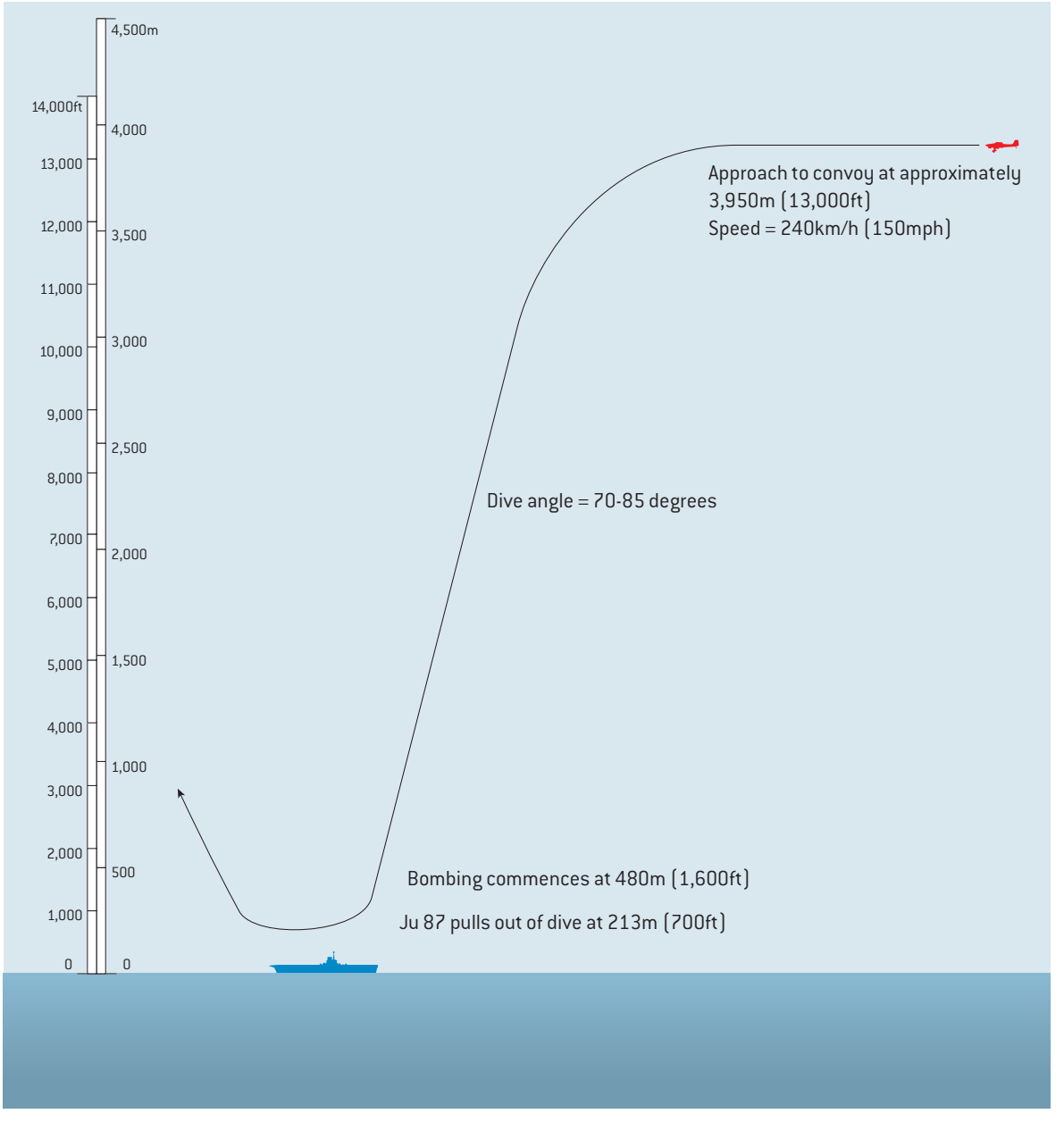
> We first concerned ourselves with the details of instrumentation and with the hydraulic system, especially developed for dive-bombing, and finally with the bomb release. After a few short briefing flights, the crews felt at ease in their closed cabins. We still had to learn how to control the Ju 87 in nose-diving. There existed no Stuka school at that time, but there was the air base at Barth, in Pomerania, where a Stuka training *Gruppe* was being built up. The instructors there first had to get familiar, by making test flights, with the new machine before they could pass their experience and skill to the other Stuka *Gruppen*. We therefore helped ourselves as best we could. We first singled out the crews. The pilot and his backseater, the latter also acting as gunner, had to be a real team; one that had to depend on each other, for better and worse. If, after a while, it was found that the pair did not harmonise, the men were replaced until pilots and their backseaters had found themselves.

The men of I./StG 160 arranged for a target practice area to be cleared in the vast Prussian forests that surrounded Insterburg, and in which was laid out a target cross surrounded by a circle ten metres in diameter. Nose-diving training flights were monitored from a nearby observation tower that had been especially erected for the job.

'We approached our target at an altitude of 5,000m', recalled Hozzel, 'extended the dive brakes shortly before the target, then brought the target into the lower cockpit window below our feet. When it disappeared at the rear edge, we put the aircraft down at a dive angle of 70 degrees. With the fuel shut off, the aircraft quickly gained speed by its own weight, whilst the dive brakes kept it at a steady pace of 450km/h.



The pilot of this Ju 87 has briefly rolled his aircraft into inverted flight prior to commencing a steep dive, during which he would bring his target into the centre of his windscreen. This aircraft is flying overland, but more experienced Stuka pilots would undertake such dives onto enemy ships. (EN Archive)



Luftwaffe dive-bombing attack profile as employed by Ju 87s against Royal Navy carriers in the Mediterranean.

'We aimed through a reflector sight, keeping the whole aircraft in the centre of the target and allowing for velocity and direction of the wind, with the aid of the right lead angles. A continuously adjustable red marking arrow was mounted on the altimeter, set to local altitude above mean sea level, from which the required bomb releasing altitude could be set. When passing that altitude in a dive, a loud and clear horn signal was sounded, warning the pilot to press the bomb-release button on the control stick and pull the aircraft out of its dive. By pressing the release button, we also automatically actuated the hydraulic recovery device, which aided the pilot under the heavy G-load encountered in steep dive recoveries.

Ju 87B COCKPIT

1. Fuel pressure gauge
2. Radio altimeter
3. Compass
4. Main electric switch
5. Starter switch
6. Rate of climb indicator
7. Altimeter
8. Bomb window control
9. Fuel gauge
10. Compass repeater
11. Artificial horizon
12. Bomb altimeter
13. KG 12A control column
14. Engine priming pump
15. Oil cooling flap control
16. Supercharger pressure dial
17. Rev counter dial
18. Airspeed indicator
19. Clock
20. Revi C/12C bombsight
21. Loading buttons
22. Test lamp
23. Hydraulic pressure switches
24. Fuel Cock
25. Instrument shroud padding
26. Cockpit ventilation control
27. Supercharger handle
28. Canopy latch handle
29. Wing bomb-arming switches
30. Oil pressure gauge
31. Fuselage bomb-arming switch
32. Wing/fuselage bomb selector
33. Bomb jettison handle
34. Hand pump
35. Rear-view mirror
36. Coolant temperature gauge
37. Oil temperature gauge
38. Fuel tank selector
39. Cockpit lights
40. Circuit breaker panel
41. Seat adjustment handle
42. Throttle
43. Propeller pitch control
44. Magnetos
45. War emergency power control
46. Electrical lead for Revi C/12C bombsight
47. Switch and test box
48. Cockpit ventilator
49. Rudder pedals
50. Pilot's seat and cushion

'The normal bomb-releasing altitude was close to 700m. Experienced pilots would also venture down to 500m in order to increase bombing accuracy. This, however, was the minimum pull-out radius needed to clear the ground in time. Below that, there was no hope left.'

Once the crews had mastered the art of nose-diving in the Ju 87, they next undertook bomb 'throwing' while diving, firstly using cement practise bombs and then, once considered sufficiently proficient, with live bombs. Ordnance had to be dropped within the ten-metre circle to be viewed as a 'hit'.

'Diving with and without bombs was part of our daily routine', Hozzel remembered. 'Besides that, we also began training in *Staffeln* as combat flying practice with the whole *Gruppe*'. The training emulated that given to Luftwaffe fighter pilots to assist in increasing the pilots' skills of manoeuvrability. According to Hozzel, 'They had to become part of the aircraft. This included starts and landings on short, bumpy emergency airfields. Occasional crash-landings could not be avoided, but this preliminary training proved most useful in anticipation of risky landings in unknown regions in the following war'.

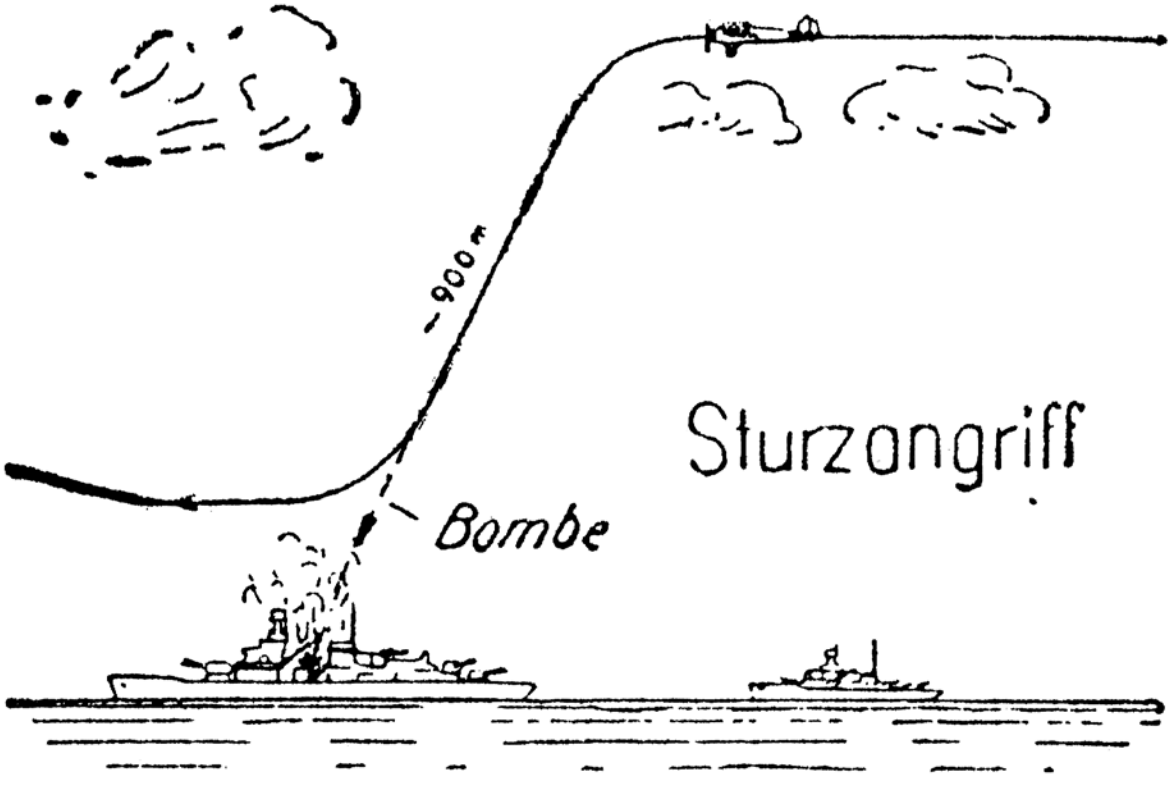
Once this aspect of training was completed, crews were given tactical instruction for envisaged operational situations, including navigation, weather briefings, understanding of the ground and air environments, anti-aircraft fire, ammunition and its replenishment, fuse-setting, take-off formations, unit leader recognition and codes, formation flying, operational altitudes, attack signals, return formations and altitudes, and landing orders and procedures.

The three *Staffelkapitänen* of I./StG 160 were rotated to the *Sturzkampflehrgang Barth* in order to exchange experiences with the senior officers there and to engage in practise with them. Instruction at Barth was overseen for a period by Oberstleutnant Günter Schwarzkopff, a former World War I pilot who would command IV.(Stuka)/LG 1 and StG 165. Training took the form of lectures, as well as small- and large-scale tactical formation flying. A memorial to Schwarzkopff records that, 'Diving skill and accuracy were of paramount importance, and under his personal leadership were continually improved and bettered. Releasing bombs when diving was scientifically and practically examined, and lessons were painstakingly learned from their dedicated experiments'.

Oberleutnant Helmut Mahlke was posted to the *Sturzkampffliegerschule Kitzingen* on 1 July 1939, having previously served as a maritime observer/navigator flying He 60s with 1./Bordfl.Gr. 196. He viewed his new posting as a significantly positive career development. 'I was like the cat that had swallowed the cream, happy beyond words at the prospect of getting back into the pilot's seat and holding the stick in my own hands again'. In his memoirs Mahlke gave his own view of the stresses faced by Ju 87 crews:

> I won't deny that individual dive-bomber pilots may have had different perceptions of the physical demands made upon them. For some, perhaps, those demands may even have been close to the limits of their endurance. But, speaking personally, the only problem I ever experienced when diving from any great height was an occasional and unpleasant build-up of pressure in my ears. This was caused by the rapid increase in external air pressure, and could usually be alleviated by the act of swallowing. A slight popping of the eardrums would then indicate that the correct balance of pressure had been restored.

Mahlke also paid tribute to the role of the backseaters:



Dive tactics evolved and were adapted to differing operational scenarios, but this contemporary sketch from a wartime manual illustrates how a dive-bombing attack should be carried out against warships. The dive itself is shown as covering a distance of 900m (2,950ft), and it was usual for pilots to pull out at around 460m (1,500ft). The use of an automatic pull-out device was abandoned in favour of an electric horn triggered by the altimeter, although this was found to be very alarming by many crews. (EN Archive)

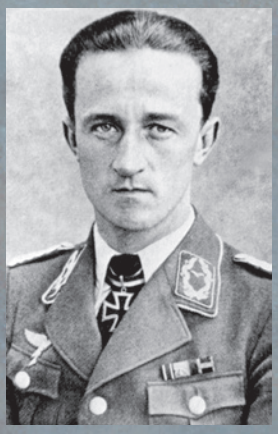
The demands made upon the gunner sitting in the rear of the cockpit of the Stuka were far greater than those required of the pilot. Facing rearwards, monitoring the airspace behind the machine and ready to let fly at any attacking fighter approaching from astern, he would often be forced to his knees by some of the pilot's more violent defensive manoeuvres. Yet I never once heard a single word of complaint from any of our gunners. They did their job with commendable courage and resilience.

During 1941, the *Stab* and two *Gruppen* of *Sturzkampffliegerschule* 2 moved to Graz-Thalerhof in Austria. Here, training methods were refined after the first five years of operational experience with the Ju 87 since its debut in Spain. The course lasted for approximately four months, during which time a trainee pilot would make around 15 flights before commencing dive practice. Prior to take-off, the pre-flight check entailed tail trim set at zero, rudder trim indicator 90 degrees from full right, flaps to start, both main tanks on, propeller good, and radiator and oil cooler open.

For an anti-shipping practice mission, cement bombs equivalent in weight to one 250kg and four 25kg bombs were usually used for thicker-skinned merchant vessels, while a 500kg load was required for warships of cruiser size and greater.

Dives were made from 3,600m and undertaken at angles of up to 90 degrees, with pull-out for trainees at around 900m. As the pilot turned into the dive, he closed the radiator flap, turned off the supercharger, tipped over, set the angle of dive, accelerated and applied dive brakes. It was exhausting work, and dives were usually restricted to a maximum of 15 per day.

WALTER ENNECCERUS



Walter Enneccerus is seen here as a newly promoted Major in 1940 and a recipient of the Knight's Cross, which he was awarded on 21 July. (EN Archive)

Walter Enneccerus was one of the Luftwaffe's leading proponents in attacking enemy ships in the Ju 87. He was born in the ancient city of Trier on the banks of the Moselle in southwestern Germany on 21 November 1911. Enneccerus enlisted in the Heer in 1930, and later undertook voluntary flying training. He was commissioned in 1933 and transferred to the Luftwaffe in 1935, receiving further flight training at the *Jagdfliegerschule* at Schleissheim. Following the completion of the latter Enneccerus remained at Schleissheim as an instructor.

In April 1936 he was posted to the newly formed I./StG 165 at Kitzingen under Major Werner Junck, the unit being equipped, variously, with He 51s, Ar 65s and Hs 123s. Enneccerus's first command position was as *Staffelkapitän* of 4. *Staffel* with the rank of Oberleutnant. The unit was redesignated 4./StG 77 on 1 May 1939 at Schweinfurt, and he subsequently led it during the Polish campaign, flying Ju 87s.

Enneccerus's performance as a junior unit leader resulted, on 16 December 1939, in his promotion to Hauptmann and appointment as *Kommandeur* of II./StG 2 *Immelmann*, leading that *Gruppe* in its operations in the campaign in the West in 1940. The unit's Ju 87s were in regular action against fortified positions in Belgium and France, including the Maginot Line. Missions against the Allied evacuation at Dunkirk followed, as well as targets at Le Havre and La Rochelle, during which his *Gruppe* sunk four ships and damaged eight. On another occasion, Enneccerus led his Ju 87s in an attack on a formation of French tanks near Philippeville, almost annihilating it. His Stukas were also responsible for blocking the movement of trains from the railway station at Evreux. For these and other actions, Enneccerus and his unit received thanks and praise from German ground forces.

In recognition of his leadership and his unit's successes, he was awarded the Knight's Cross on 21 July – only the second Stuka pilot recipient of the decoration – and shortly thereafter was promoted to Major. Enneccerus had a reputation for honesty and for considering the interests of his crews as paramount.

II./StG 2 flew several missions during the campaign against England in the summer of 1940, striking enemy shipping in the English Channel and targets along the South Coast.

Enneccerus, known as 'Ennec', would win great renown as a result of his action against the carrier *Illustrious* in the Mediterranean in January 1941. On the 10th of that month, while flying from II./StG 2's Sicilian base, and alongside the Ju 87s of I./StG 1, the *Gruppe* claimed to have hit the carrier several times west of Malta, resulting in it being forced to withdraw from service for more than a year and to travel to the United States for repair. The *Gruppe* was also successful in inflicting damage on the British carrier *Formidable*, as well as setting the cruiser HMS *Southampton* ablaze southeast of Malta and damaging the destroyer HMS *Nubian*.

Towards the end of 1941, Enneccerus attended a unit leader's course at the Air Warfare School at Gatow. During the first half of 1942, he fulfilled staff appointments and flew operations over North Africa. He also held staff positions on the Eastern Front from the autumn of that year, and was appointed to command StG 77 from 13 October. However, Enneccerus's leadership of that *Geschwader* would be short-lived, and he is believed to have been relieved of his command for refusing to carry out orders that he considered to have been suicidal for his unit then in service in southern Russia. He left StG 77 on 20 February 1943, a decision linked, 'officially', to stress brought on by over-work and the death of his father. He was spared a court martial and returned to Germany on extended leave, taking a vacation with his family in Kitzbühel.

From then until the end of the war, Enneccerus was assigned to various staff positions and was promoted to Oberst im Generalstab on 1 April 1944. He is believed to have flown more than 200 missions. After the war, Enneccerus joined the Bundeswehr, serving ultimately as Chief of Staff of the *Allgemeinen Luftamtes* (General Air Office) in Bonn-Porz. He retired as a Brigadegeneral. Walter Enneccerus died in Wahn on 3 August 1971, a few months after his retirement.

ROYAL NAVY POM-POM TRAINING AND HACS

Whale Island is a partially man-made 'island' that lies on the eastern side of Portsmouth Harbour in the city that is considered the historic home of the Royal Navy. The island was built from waste and spoil resulting from the building of the nearby naval docks, basins and associated installations. It underwent great expansion in the late 1800s and became the Royal Navy's School of Gunnery in 1891.

Prior to the establishment of the school, gunnery was practised on a number of hulks that lay in the harbour, it being the responsibility of the commanding officers of ships to ensure that their crews were trained in the art of gunnery. Trainees would fire their guns at a range established on Whale Island, with instructors simply ordering their gunners to hit first, hit hard and keep on hitting. But as the ranges of guns increased dramatically during the Victorian era and the number of officers and men requiring training ballooned, HMS *Excellent* was established ashore in 1891.

Eventually, gunnery training became specialised, particularly following the introduction of the military aeroplane. During and after World War I, alongside its instructional role, *Excellent* also became involved in designing and producing gunnery-related equipment and aids, such as slide rules for calculating angles of fire and range from curves, heights and sight angles, as well as plotting boards and directors. It also recommended improvements and alterations to gunnery equipment based on training experience.

But gunnery was to be a divisive subject. Paradoxically, in a review of 1931, the Naval Anti-Aircraft Gunnery Committee opined that attacks against ships by dive-bombers would not be a likely threat. Its view was supported by the RAF, which believed that dive-bombing could only be effective with purpose-built aircraft, and that the very nature of their single purpose meant that such bombers would not appear in significant numbers. Yet the following year, Rear Admiral, Aircraft Carriers, Sir Reginald Henderson, warned, 'the primary defence of the fleet against air attack (by gunfire) is not justified by data or experience. No realistic firing against aircraft has taken place since the last war and, in my opinion, the value of our own High Angle Control System Mk I is rated too high. In common with others, we are apt to over-rate the capabilities of our own weapons in peacetime.'

Nevertheless, by the outbreak of World War II, the gunnery school had become a centre of excellence under the command of Capt Arthur F. E. Palliser. The approach of the staff at *Excellent* was to create a 'user'-based establishment that also embraced gunnery development. The functions of *Excellent* were stated as, 'To ensure that the development of naval gunnery proceeds on lines dictated by sea experience rather than office expediency', and 'To ensure that the gunnery equipment of HM Ships be fitted to the satisfaction of the user rather than the manufacturer'.

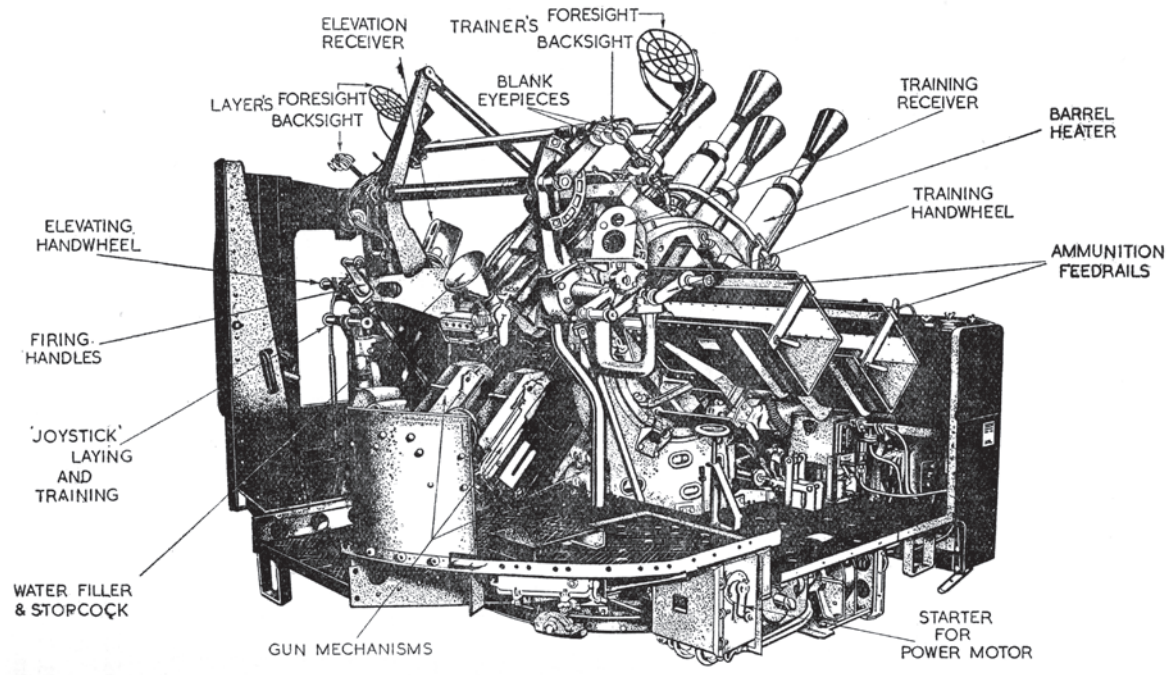
Capt Palliser had joined the Royal Navy in 1907 and had attended *Excellent* himself between 1923–25, following which, in the early 1930s, he served for periods as fleet gunnery officer in the Mediterranean. Palliser and his successors during World War II

TWO-POUNDER POM-POM

The crew of one the six eight-barrelled two-pounder pom-poms on board *Indomitable* work frantically to bring their guns to bear on a Ju 87 from Major Herbert Spangenberg's I./StG 3 as it dives towards the carrier moments after the 500kg bomb from another Stuka strikes the waters close by. This action took place north of the Tunisian coast on 12 August 1942 during Operation *Pedestal* when the *Gruppe* sent 12 Ju 87s to attack the Royal Navy convoy. They scored two direct hits on the carrier and three near misses, leaving its flightdeck inoperable. Two Ju 87s failed to return to their base at Trapani.

oversaw a tightly run establishment. They had to, for gunnery was vital to the safety of a warship. As the Admiralty's standard-issue *Gunnery Pocket Book* emphasised starkly:

> You must practise again, again and again. In the same way as a professional boxer goes through an intensive course in training before fighting his adversary, so it is necessary for you, the gunnery men of the ship, to get yourselves into training for fighting the enemy. The only difference between you and the professional footballer, cricketer, or boxer, is that whereas they are going to enter a contest for which they will get prize money, you are going to fight an enemy who, if you are not fully efficient, well trained, and in practice, will kill you.
>
> Remember this: when you are detailed in the day's gunnery orders to close up at your gun, your director, or your telephone, be there punctually. You may meet the enemy at any



This drawing of the quadruple two-pounder pom-pom on a MK VII mounting was taken from *The Gunnery Pocket Book* (B.R.224/45), issued by the Admiralty in 1945. (Robert Forsyth)

> time and in any weather. You may not have had long to practise; see that you do not curtail that time by being adrift. Your own life and the lives of your shipmates may depend on you.

One former officer trainee, John Carter, recalled his gunnery training after being posted initially to the shore establishment HMS *Collingwood* in Fareham. 'Two weeks later I was drafted to HMS *Excellent* based on Whale Island in Portsmouth Harbour. If I thought *Collingwood* was tough *Excellent* was to prove considerably tougher. Discipline was absolutely strict, and whilst under instruction you doubled everywhere.'

The memory of Londoner Ordinary Seaman Bernard Howe, who volunteered as a gunnery rating in the summer of 1942, was similar:

> I was very interested in gunnery, especially anti-aircraft gunnery. The Navy asked you what you wanted to be – a gunnery rating? A torpedo man? I volunteered to be a gunnery rating. After a two-week posting to Victory Barracks in Portsmouth in July 1942, where time was spent on drill and waiting to be posted to a ship or a shore-based assignment, I spent a month at HMS *Christopher* Shore Station in Fort William, Scotland for ML [motor launch] and MTB [motor torpedo boat] training.

The gunnery training manual stressed that in aircraft recognition, 'There are three things you must learn about enemy aircraft: to be able to *recognise* them; to know their *speeds*; to estimate their *range*. You may have to decide for yourself whether or not to fire at it.' While at *Excellent*, Bernard Howe was given instruction in aircraft recognition, learning to identify both friendly and enemy types:

They showed you different planes all the time; German planes, British planes, and the markings on them . . . crosses, Swastikas, roundels. They tested you with pictures. You also had to learn to estimate flying heights and speeds too, with positioning in degrees, and also to identify formations. I then went to HMS *Excellent*. It was very pukka. You had to be at your best behaviour all the time. There was no slacking. It was a proper gunnery training school. You had to wear ankle gaiters. If you went ashore not dressed properly you were in terrible trouble. You couldn't walk on the parade ground, you had to double march. If you did do anything wrong, you had to run around the island with full kit on, which was blooming hard work!'

The anti-aircraft guns at *Excellent*, which comprised 20mm Oerlikon and twin, quadruple and octuple two-pounder pom-pom units, were set up in brick-lined pits along the shore that were accessed down flights of steps. John Carter remembered, 'The course lasted eight weeks, during which part of the practical training involved a spell at the gunnery range at Eastney on the outskirts of Portsmouth. All types of weaponry were on site, including eight-barrelled pom-poms, two-pounders and an assortment of smaller guns.'

Bernard Howe recalled:

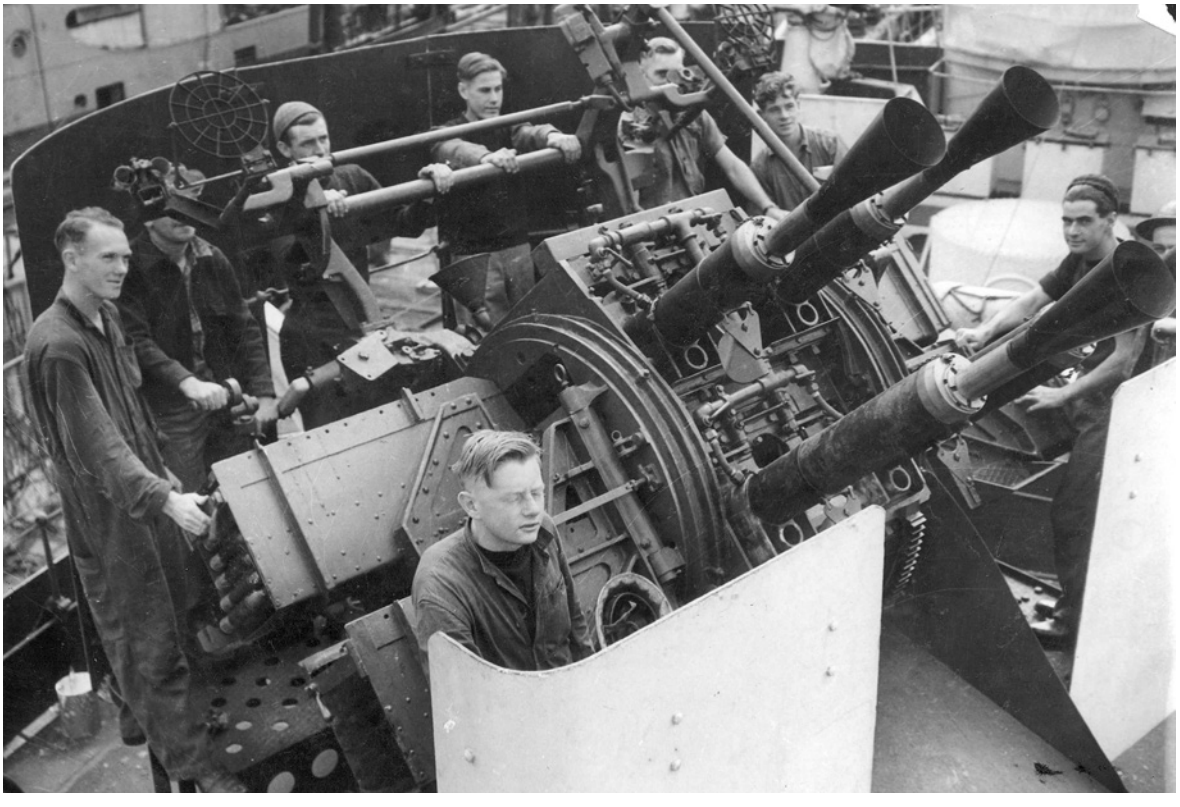
We were trained on both the pom-pom and the Oerlikon. Initially, you were a loader, and you were trained how to load the guns. The Oerlikon shells came in a drum, which had keys on the front. You lifted it, mounted it on the gun itself and clipped it down. I think a drum held 50 rounds. The gun had two curved bars that fitted into your armpits and you were then strapped to the gun with a buckled harness. There was splinter protection on either side in front and a big 'spider's web' sight. If an aircraft was coming at you at 100mph, you'd move the barrel an inch or so to the left. It was very easy to control.

A very important aspect to gunnery training was what happened if a gun stopped. If it stopped, you had to know what to do. You had a wooden mallet for such occasions, and if a gun stopped – *wallop*! Quite seriously – you gave the gun a clout. You had to understand the position of the gun when it stopped, and whatever position it was in, there was a drill. An aircraft would fly overhead, with a trailing target behind it, and you'd have to fire at the target. You made sure you didn't fire at the aircraft! They also taught you the principles of deflection. You had try to assess what speed the aircraft was doing so you then knew how far in front of it you should fire. You also had to assess how far away the aircraft was. You soon got the hang of it.

John Carter recounted:

One evening the air raid sirens sounded and we all took up predetermined positions at the various guns. Shortly after, a lone German aeroplane flew along the coast right in front of the range; we let fly with everything but the aeroplane passed immediately in front of us apparently unscathed. Clearly more practice was needed! At the end of the course I qualified as an AA3, meaning I was able to handle smaller calibre anti-aircraft guns and entitled to wear the appropriate badge on my sleeve. I also received an additional three pence per day to add to my two shillings per day!

At sea, in the words of the Royal Navy's *Gunnery Pocket Book*, the role of the Close Range Guns crews, such as those manning the two-pounder pom-poms, was considered to be the '"commando troops" of the ship':



Ratings take the position of a quadruple two-pounder pom-pom crew on a Mk VII mounting in this posed photograph taken aboard the Royal Australian Navy destroyer HMAS *Napier*. To the sides of the guns are the ammunition containers, with feed rails on top. Directly beneath the platform on which the sailor at far left stands would be the starter motor to power the mounting. The sailor second from left holds the training handwheel and looks through the circular trainer's foresight. The funnel-shaped cap is the water filler and stopcock. The sight to the right is the layer's foresight. (Argus Newspaper Collection of Photographs, State Library of Victoria)

> They have got to be tough, well disciplined, and capable of withstanding hardship. They are not protected from the weather or splinters and have got to be able to keep cool and collected, and shoot accurately in spite of all that is going on around them.

All Gunnery Officers (and Gunnery instructors) were trained to have very loud voices – a habit they never seemed to lose even as they rose to higher ranks! A little less exposed to the elements at least were the crews of the 4.5in. QF guns installed on the Illustrious-class carriers. Overseeing these guns would have been a High Angle Fire Control Team. The origins of these teams lay in the late 1920s when the Admiralty contracted Vickers to develop a High Angle Control System (HACS). This was to be fitted into capital ships, aircraft carriers and cruisers in an attempt to quickly introduce a relatively simple, low cost solution to the problems of 'operating unstabilised guns and an unstabilised director on a ship in motion' and to significantly reduce the element of human involvement. By 1939, following a process of development, the HACS Mk IV entered service, but despite the goal of simplicity, the system still required a crew of well-trained and skilled operators and specialist equipment.

A High Angle Fire Control Team was commanded by an Air Defence Officer (ADO) who was responsible for ensuring that no enemy aircraft approached without being engaged. He selected targets from an air defence position near the bridge. His Assistant operated the ADO's sight. The ship's radar was operated by Long-Range Warning Radar Set Operators who picked up aircraft at long range and relayed

ARTHUR WILLIAM LA TOUCHE BISSET

As a Captain, Arthur William La Touche Bisset commanded *Formidable* from 7 August 1940 to August 1942 – a period during which the carrier was active in the Mediterranean, its aircraft launching attacks against Ju 87s and also suffering attacks by them. Bisset was born on 6 April 1892, the son of Col Sir William Sinclair Smith Bisset and Henrietta Mary La Touche of Stoke Poges in Buckinghamshire. He was educated at Fonthill School in East Grinstead, where he was a keen player of sports, before joining the Royal Navy on 15 January 1905.

Bisset specialised in gunnery and was posted firstly to the battleship HMS *King George V*, before becoming a Gunnery Lieutenant on the cruiser HMS *Devonshire* and the battleship HMS *Iron Duke*. In 1922 he attended Staff College at Greenwich, before completing a further month-long gunnery course at HMS *Excellent* in the summer of 1923, after which he joined the battleship HMS *Barham* as Gunnery Officer for service in the Mediterranean from July 1924 to May 1926. Bisset spent much of the following two years assigned to the Admiralty Gunnery Division, before being appointed Squadron Gunnery Officer for the Battle Cruiser Squadron of the Atlantic Fleet aboard HMS *Renown*.

His first stint on a carrier came in July 1931 when he was appointed Executive Officer of *Glorious* in the Mediterranean. His commanding officer had the 'highest opinion of his ability. He is full of initiative, has good judgement, though sometimes over-confident. Has plenty of brains and knows how to use them. Not afraid to tackle any job.' Clearly in line for greater things, Bisset attended senior officers' technical and tactical courses in Portsmouth for the next three years, before being given command, in March 1934, of the seaplane carrier HMS *Ark Royal*, which was renamed HMS *Pegasus* on 21 December that year, serving as a naval aviation training ship. Bisset's subsequent career continued to be varied, with a further course at Naval War College in Greenwich, after which, on 5 September 1935, he took up the position of Director of Physical Training and Sports at the School of Physical and Recreational Training in Portsmouth.

When war broke out, he was commanding the heavy cruiser HMS *Shropshire*. Vice Admiral J. H. D. Cunningham wrote of this time that Bisset was 'quite devoid of "nerves" and handles his ship boldly and most efficiently on all occasions'. Cunningham further commented that Bisset was 'fit for more important sea command'.

In March 1940 Bisset was posted as British Naval Liaison Officer firstly to Brest and then to Casablanca. He returned to the Admiralty for a brief course at the Imperial Defence College, before being appointed commander of *Formidable* on 7 August 1940, which at the time was still being completed. Bisset commanded the carrier during the Battle of Matapan in March 1941, and the following month oversaw the protection of troop convoys during the Allied evacuation of Greece. *Formidable* was attacked by Ju 87s in May but survived, and in May of the following year it was in Mombasa, before proceeding to the Bay of Bengal with *Illustrious* to draw away Japanese attention from the American landings at Guadalcanal.

Bisset was Mentioned in Despatches for 'gallant and distinguished services in operations in the Mediterranean'. In May 1942, his performance in the Mediterranean was noted as 'above average and during recent operations has shown excellent judgement and initiative. Recommend for immediate promotion to Flag rank.' In July 1942, after a period as Naval Aide-de-Camp to the King, he was promoted to Rear Admiral, Naval Air Stations, Indian Ocean, before taking command of 'Force H' and, finally, on 12 March 1944, becoming Rear Admiral, Escort Carriers. He retired with the rank of Vice Admiral on 1 February 1946 and died on 23 June 1956.

Capt Arthur L. Bisset, Captain of *Formidable* (left), and Adm Sir James Somerville, Flag Officer Commanding Force H, walk along the carrier's flightdeck in early 1942. Note the lift opening behind the two men and the barrels of the 4.5in. QF Mk III guns to right. (IWM)

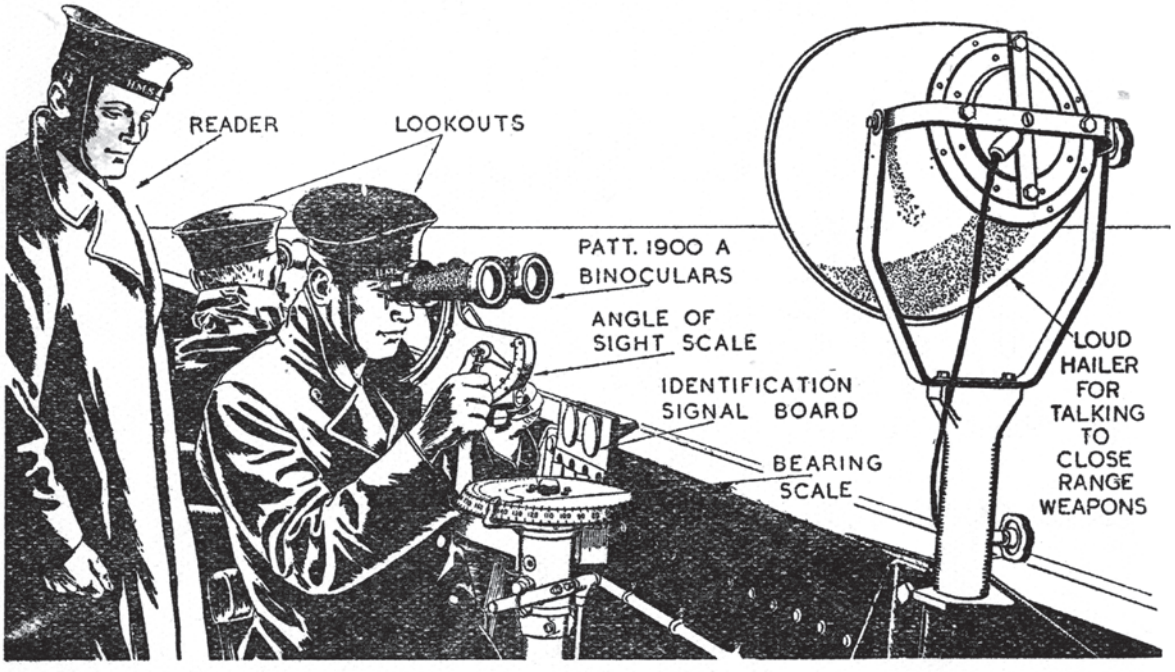


Diagram 37.—AIR LOOK-OUT (A.L.O.) POSITION.

information to the ADO via the Action Information Centre. A team of Air Look-outs used binoculars to continually sweep an assigned arc for which each member was responsible. As soon as an aircraft was spotted, the Look-out kept it in his binoculars until he received further orders from the ADO.

Upon receipt of information on an enemy aircraft from the ADO, the High Angle Control Officer gave the necessary orders to the calculation position for opening fire, and subsequently spotted the bursts onto the enemy aircraft. The High Angle Director's Crew consisted of the Director Layer, the Trainer and the Range-taker, who monitored the enemy aircraft continually, the former firing the guns electrically. A team of radar ranging set operators moved the radar's aerials mounted on the director to keep them trained onto the target.

The crew in the High Angle Calculating Position (HACP) comprised a Phone Man, Deflection Screen Operator, Plot Operator and operators for the Auto Barrage Unit and Range Transmission Unit. Information collated by the HACP was passed continually to the guns. The HA table also sounded a fire buzzer automatically at regular intervals that told the Director Layer when to fire. The Gunlayers and Trainers manning the HA guns had to follow the movement of electrical pointers in the elevation and training receivers. It was vital that the correct sequence of setting fuses and the loading of a fused shell into the guns was carried out by the guns' crews, since each shell carried a fuse that was correct only for that moment.

In its initial forms, the HACS system threw up a barrage of exploding shell through which any attacking dive-bomber would have to fly in order get close enough to the ship.

Air Look-outs were a vital part of the air defence of a ship. They were stationed near the Air Defence Position and worked in pairs, relieving each other every 20 minutes. Once an Air Look-out spotted an aircraft, he was not to take his eyes off it until the ADO found the target. The rating not closed up at the seat read off the bearing and angle of sight. Look-outs were assigned 'sectors' of 60 degrees to search. (Robert Forsyth)

COMBAT

Since its arrival in the Mediterranean at the end of August 1940 to reinforce Adm Cunningham's fleet, the presence of *Illustrious* under Capt Dennis W. Boyd, with its low-angle radar and Fulmar fighters, was the cause of considerable strife to Italian forces. As previously mentioned, on 10–11 November aircraft from *Illustrious* had successfully sunk an Italian battleship and crippled two more at Taranto. By December, the carrier's offensive activities in the eastern basin and central part of the Mediterranean Sea had accelerated and, deploying its Swordfish torpedo-bombers, *Illustrious* had executed a series of strikes against Italian airfields and installations on the Greek Islands. Carrier-based aircraft had also engaged enemy forces in North Africa while supporting the British Eighth Army in Libya, as well as attacking Italian merchant shipping off Tunisia. On 22 December, Swordfish from *Illustrious* struck Tripoli.

Despite considerable Italian naval strength and shore-based aircraft in the region, offensive operations during December 1940 had demonstrated the extent to which the Royal Navy was able to exercise control in the Mediterranean – largely as a result of taking opportunities when they were available, and as such, convoys and warships had made safe passage east- and westbound.

Before dawn on 7 January 1941, *Illustrious* departed Alexandria along with the battleships HMS *Warspite* and HMS *Valiant* and seven destroyers comprising Force A. As part of Operation *Excess*, this force was intended to provide cover for the passage of three ships to Piraeus and one to Malta with badly needed supplies, and two convoys sailing out of Malta on 10 January bound for Alexandria. The latter were the slow-moving M.E.6, comprising five freighters and two tankers escorted by three corvettes, and the fast M.E.5½, made up of two empty freighters escorted by a cruiser and a destroyer. The merchantmen would be particularly vulnerable as they steamed through the narrower waters around Malta.

Ju 87R-2s S1+HK and S1+AK of 2./StG 3 fly over Rhodes harbour in the spring of 1941. The aircraft have a generally worn and repainted appearance, evidence of considerable operational usage in northern Europe prior to their arrival in the Mediterranean. What appears to be a chevron forward of the fuselage code is visible on S1+AK, denoting prior use by a *Gruppe* Adjutant or similar *Stab* function. (EN Archive)

Adm Cunningham was in *Warspite*, and aboard *Illustrious*, both Capt Boyd and Rear Admiral Arthur Lumley Lyster, Rear Admiral, Aircraft Carriers Mediterranean, had recommended to Cunningham that the carrier be detached from Force A so as to act independently from a position south of the group, and thus further away from any enemy aerial threat operating from airfields on Sicily. Furthermore, air cover could be maintained over the fleet from such a position without difficulty. Cunningham resisted this suggestion, however, believing that *Illustrious*, sailing with the battleships, would have a great morale-boosting presence for the fleet and the merchantmen.

Meanwhile, to avoid the effect of any more reckless military 'adventures' by *Il Duce*, Hitler agreed to send a significant air contingent south to the Mediterranean with which to assist the Italians. Its principle objectives were neutralising Malta as a base for British air and naval forces by strong aerial bombardment, thus securing the Axis supply route from Italy to North Africa; to interdict the British supply route to North Africa, and from Gibraltar to Malta; and to close the channels around Sicily to British ships. In addition, the Luftwaffe would support Axis forces in North Africa.

To this end, in early January, X. *Fliegerkorps*, with just over 250 aircraft under the command of *General der Flieger* Hans Geisler and his Chief of Staff, Oberst Martin Harlinghausen, which had previously coordinated Luftwaffe anti-shipping operations off Norway, was to transfer to the south. As *Illustrious* and Force A steamed northwest, Geisler arrived in Sicily and set up his headquarters at a hotel in the hilltop town of Taormina.

ENGAGING THE ENEMY

Ju 87Bs dive steeply towards the deck of *Illustrious* during the attack between Linosa and Malta on 10 January 1941. The Stukas' tactics were to enter a dive from altitudes of between 3,500 to 2,100m at an angle between 70 to 90 degrees. At between 450 to 240m, the Ju 87s would release their bombs and pull up to 40 to 45 degrees, although many pilots would choose to pull up at a shallower angle in order to suppress the carrier's anti-aircraft batteries with machine gun fire. Using dive brakes, speed was maintained at 500-600km/h. When released at such low altitudes, bomb fuses had to be set to two to four seconds after impact, meaning that aircraft Nos. 2 and 3 in an attack would have to follow closely behind the lead aircraft, as seen here – a practice which many Stuka pilots mastered.

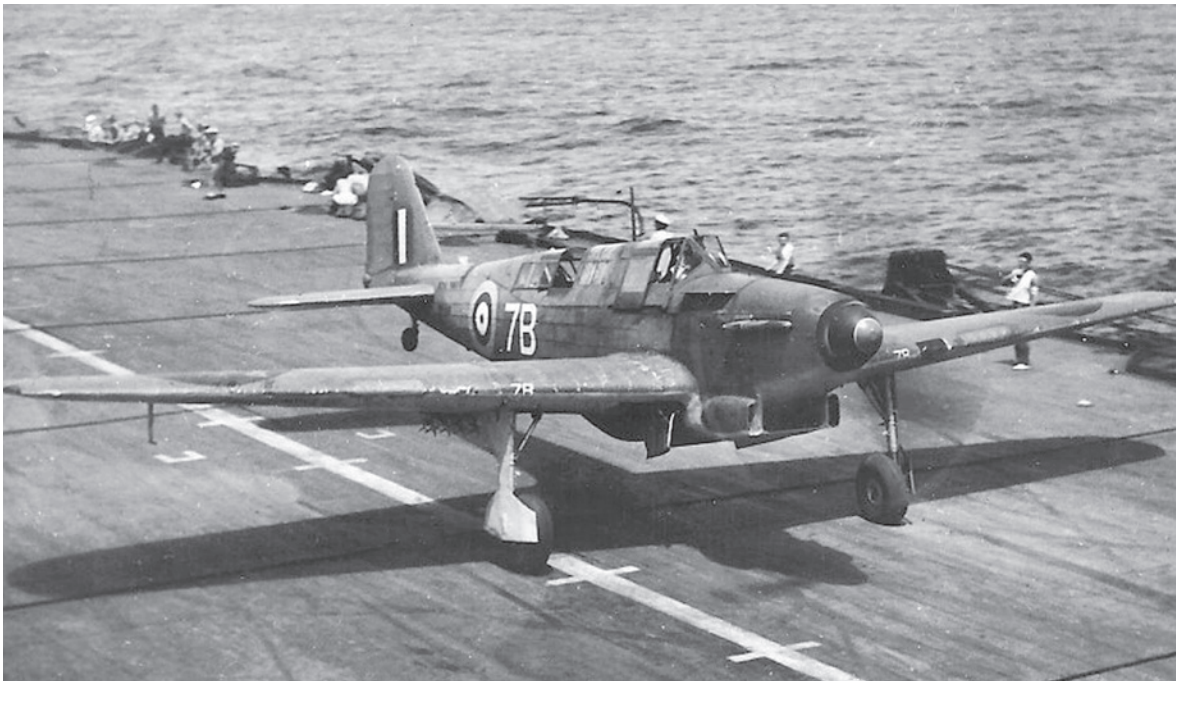
In mid-December Geisler's command comprised a *Staffel* of Ju 88 reconnaissance aircraft, 34 Bf 110s from III./ZG 26, 103 Ju 88 and He 111 bombers from LG 1, II./KG 26 and 2./KG 4 and 31 Ju 52/3ms from KGr.z.b.V.9. In addition, he had a powerful dive-bomber element under the tactical direction of the *Stab*/StG 3 (Oberstleutnant Georg Edert), made up of 39 Ju 87Rs of I./StG 1 under Hauptmann Hozzel and another 39 such machines from II./StG 2 under Major Enneccerus. Both *Gruppen* moved to Trapani on the west coast of Sicily and were installed within the first few days of January. From here, they would be deployed against British ships sailing between Sicily and North Africa. On the morning of 7 January, an Italian

reconnaissance aircraft had spotted Force A. The scene was set for the first encounter between *Illustrious* and the Stukas.

As Paul-Werner Hozzel recorded, 'On or about 10 January the *Geschwader* [Hozzel is referring to the *Stab*/StG 3, I./StG 1 and II./StG 2 grouping] received news that the British aircraft carrier *Illustrious* was bound from Gibraltar for Malta. It was expected to pass the island of Pantellaria, south of Trapani, in the next few hours. It was said to be cruising quite unsuspectingly and as if the British ruled the Mediterranean, proudly ignoring the existence of any Italian fleet or air force, not to mention the German Stukas on Sicily. It seemed to be a fine catch for us. It was decided to attack the carrier, taking it by surprise. Our two *Gruppen* prepared for action, loading up with 500kg bombs with armour-piercing heads. Soon we were given the operation order.'

Harlinghausen approached his task scientifically. He believed that four such bombs would be needed to sink an armoured carrier, and as soon as they reached Trapani he ordered his Ju 87s crews to carry out practice attacks on buoys laid out in the sea off the Sicilian coast in roughly the same shape as a carrier. He also set about a plan in which the Fulmar fighters aboard *Illustrious* would be drawn off by an initial attack mounted by Italian S.79 torpedo-bombers. The first Ju 87s to engage would drop 250kg bombs with very short delay fuses to be used against the carrier's anti-aircraft guns and their crews, and once these had been neutralised, 500kg bombs would be dropped by the more experienced Stuka crews, who would aim to sink the ship.

Thus, at 1220 hrs on 10 January, 52 nautical miles west of Malta, two S.79s attempted to make a low-level attack against the British warships. The carrier opened long-range and pom-pom anti-aircraft fire at the torpedo-bombers, but they completed their run-in, dropping their torpedoes at a distance of 2,500 yards off the carrier's starboard beam. *Illustrious* took avoiding action and the torpedoes passed astern.



Fulmar '7B' of 808 NAS takes off from *Ark Royal* in the Mediterranean in 1941. 808 Sqn, commanded by Lt Rupert Tillard, was the second to be formed on the Fairey fighter. The first prototype Fulmar flew in January 1940, and the initial 12 production aircraft were delivered in June. The two-seat carrier fighter was armed with eight wing-mounted 0.303in. Browning machine guns, making it comparable to the Spitfire and Hurricane, but the weight of the second seat, wing-folding gear, arrester hook and deck-handling equipment placed a burden on its Rolls-Royce Merlin engine. The Fulmar also suffered from a lack of rear-firing armament. (EN Archive)

Smoke rises from the hole caused by one of the bombs dropped on *Illustrious* by the Ju 87s of II./StG 2 and I./StG 1 on 10 January 1941. This is probably the damage caused by the fourth, fifth or seventh bomb to hit the ship, all of which fell in and around the after lift well. The deck and bulkheads in the immediate vicinity were perforated by numerous splinters. The after lift itself was in the Up position and was forced upwards by an explosion, distorted, split and came to rest leaning into the lift well. Just visible to the right are the two barrels of the port aft 4.5in. guns. (armouredcarriers.com)

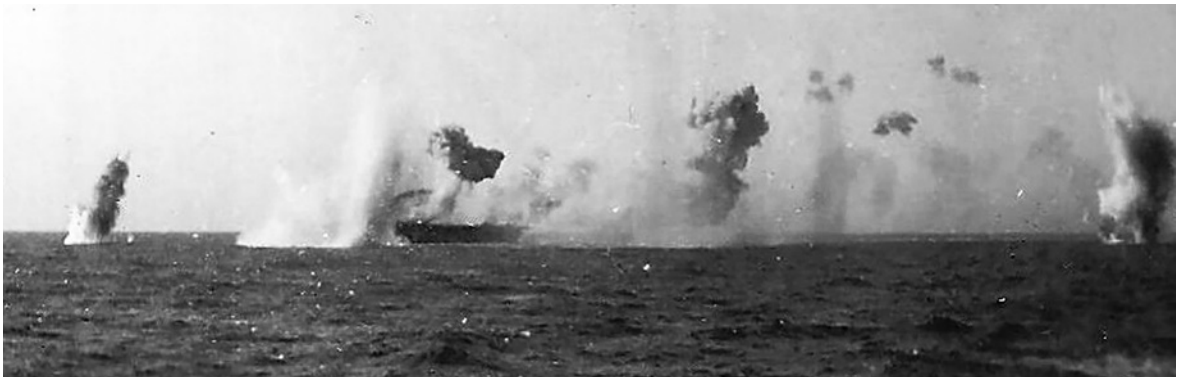
The S.79s were chased off and pursued by two Fulmars that had been launched from the vessel with instructions to undertake a combat air patrol (CAP) at an altitude of 14,000ft above the fleet.

At 1225 hrs, as the Fulmars were occupied with the torpedo-bombers, an ominous trace was picked up by radar 28 miles away to the north – a large formation of aircraft was approaching. Soon, they were identified as Ju 87s and Ju 88s. Capt Boyd on *Illustrious* recalled the CAP and began to turn into wind in order to launch more aircraft. Eight minutes after the trace on the radar, the carrier turned back on a southeasterly course, and 43 Ju 87s led by some 15 machines from Major Enneccerus' II./StG 2, followed by aircraft from I./StG 1, commenced their attack. Ten of the Stukas split away to bomb *Warspite* and *Valiant*, and this tactic drew away the battleship's guns from covering *Illustrious* just as a second formation of three Swordfish and four Fulmars was taking off from its deck at 1234 hrs as ordered by the Fighter Directing Officer.

One minute later, a 'large formation' was sighted on the starboard quarter, and at 1236 hrs *Illustrious* opened fire. One minute after that, the last of the carrier's aircraft left the deck, and at 1239 hrs the dive-bombers began 'falling from the sky' towards the warship. From the carrier, the Stukas appeared to be flying in a very loose formation, constantly changing height and position as long-range fire from the 4.5in. QF Mk III guns of B group on *Illustrious* opened up. The guns of A, Y and X groups were unable to engage the dive-bombers at this point because aircraft were still launching off the carrier.

The Stukas were reported as commencing their dives at 12,000ft, then going into their aiming dives at 6,000-8,000ft. Bombs were released by the first wave at 1,500ft and by the second from 800ft, with most of the Ju 87s continuing to dive after releasing their weapons. As they did so, *Illustrious* maintained long-range, controlled fire, as well as pom-pom fire, but the gunners found it challenging to hold their aim as the Stukas continuously weaved and changed their direction of flight in evasive action. As soon as fire from the carrier's guns became effective, the formation split into two roughly equal-sized groups, one of which worked around the stern and to starboard of the fleet, while aircraft from the other group began their attacks.

Despite the ensuing onslaught, the gunnery crews aboard *Illustrious* put up a stout defence, with a barrage fire eventually being maintained by all 4.5in. groups to a range of 1,500 yards and the pom-poms operating under local control. Nevertheless, *Illustrious* was hit no fewer than six times, and there were at least three very near misses.



Bombs envelope *Illustrious*, leaving its hull just visible. One bomb has hit the carrier's flightdeck. (armouredcarriers.com)

The first bomb, thought to have been a 500kg device, went through the loading platform of the P1 pom-pom at 1238 hrs and struck the top of the side armour, but without bursting. However, the gun went out of action because the stanchions and guard rails behind the Trainer's position and Trainer's platform were bent downwards and jammed against the fixed structure. Another bomb passed through the flares just abaft P1's searchlight and burst upon hitting the water. It caused little damage, bar extensive perforation to the bow by splinters and the smashing of the left end reflectors on the Heightfinder of B group's Director.

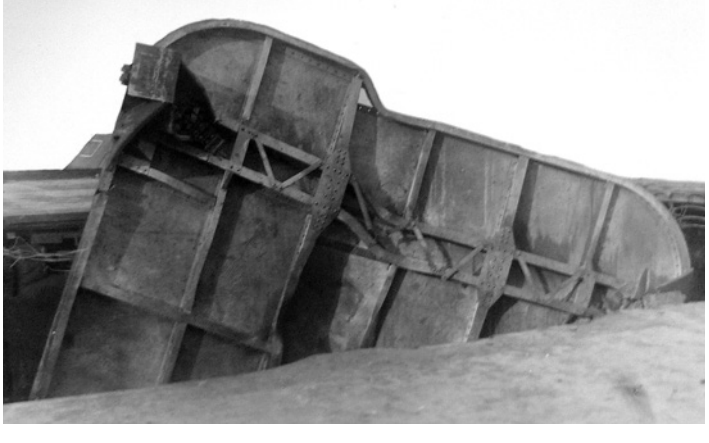
The second bomb to hit the carrier, again thought to have been a 500kg weapon, went through the flightdeck right forward on the port side, through a rest area and exploded, causing a large number of fragment holes and tearing the ship's side in two places. It caused a fire to break out in the lamp room and decontamination store and flooding in the paint store and spare anchor gear store to a depth of three feet. The third hit was by one of the 250kg bombs aimed at the S.2 pom-pom, which killed the crew and most of the personnel manning the S.1 gun, although there were no casualties on the nearby bridge. This bomb also destroyed the flightdeck travelling crane, whose jig fell across S.1, jamming the pom-pom in training and elevation for the rest of the action.

The view looking to starboard across the flightdeck of *Illustrious*, showing the after lift protruding over the deck. (Robert Forsyth/ADM267/83)

The tactics devised by Harlinghausen and Enneccerus seemed well thought out, as a post-action report prepared by Capt Boyd confirmed:

> The early damage to S.1, S.2, P.1 and P.2 pom-poms and the silencing of the two after groups of 4.5in. guns certainly enabled the later attacks to be pressed well home from a low height.

The fourth bomb, yet another 500kg weapon, hit the after lift and some pump motors, cut all electric leads to X and Y groups' 4.5in. guns and wiped out the after 4.5in. supply parties. The ensuing fire rendered both groups of guns untenable.



The poms-poms on board *Illustrious* put up a barrage defence as a bomb from a Ju 87 achieves a very near miss off the carrier's starboard side. (armouredcarriers.com)

Photographed by a Stuka backseater, six Ju 87Rs of I./StG 1 return from a mission, flying parallel to the North African coast, with the waters of the Mediterranean as a backdrop. Just visible on the upper nose of the aircraft closest to the camera is the *Gruppe*'s stylised diving raven emblem. (EN Archive)

Another 500kg bomb fell into the starboard forward corner of the lift well, before sliding off it and exploding amidst already damaged aircraft. The sixth bomb to hit the ship pierced the flightdeck and burst into the hangar deck, in which it made a large hole, before exploding in the wardroom flat. The bomb blew up the foremost lift and bulged the hangar deck forward. The combination of this and the effect of the fourth bomb wrecked the hangar fire screens and set fire to C hangar. It also wrecked the Conveyer for the after 4.5in. guns. There were many casualties in both the wardroom flat and the hangar. All leads and piping through the wardroom flat were destroyed and fires broke out in the cabin flats and the upper deck abaft 156 bulkhead. In addition, the near misses caused splinter damage and further casualties.

After completion of their dives, the Ju 87s flattened out low over the water, having crossed the flightdeck. At least one Stuka was seen to strafe the carrier, but the S.1 (despite its crew suffering casualties), P.1 and P.2 pom-poms went into action immediately.

Illustrious had been hit hard. At 1255 hrs its electric steering gear became disabled and the rudder failed. Boyd ordered the flag signal 'I Am Not Under Control' raised as the ship's engines struggled to maintain course.

From Hozzel's account, upon his return to Sicily after the mission Enneccerus underestimated the success of the Stukas, reporting only four direct hits on *Illustrious*, although the Luftwaffe crews did sense that their attack had come as a complete surprise to the Royal Navy. Whilst, the Ju 87 crews could be justified in toasting a success of sorts, the fact was that although they had inflicted serious damage on *Illustrious*, they had not succeeded in sinking it. The realisation was that an armoured carrier was a tough target.

The Fulmars had also engaged. The HA guns had opened fire as soon as the aircraft of Lts Bill Barnes and Desmond Vincent-Jones left the deck in company with that of Sub-Lt Ivan Lowe and his gunner, LA Kensett. At 1,000ft the Fulmar crews spotted the dive-bombers attacking the ship. 'Chased two of these as they pulled out and they separated', Barnes reported. 'S/Lt Lowe attacked one while we attacked the other; the latter pulled up in a steep zoom and I was able to get in a short burst before my aircraft stalled. The enemy rear gunner fired, obtaining one hit from above through hydraulic pipes in the rear cockpit.

'Climbed to 6,000ft and observed single Ju 87 slightly above us over convoy. Pursued it, and as we approached it jettisoned its bomb and turned northward. Got in long bursts from astern – the first put rear gunner out of action and subsequent bursts caused it to go down in shallow dive into the sea, the pilot having been hit. Ammunition being expended, we made for Malta, landing at about 1345.'

Lowe and Kensett in aircraft 6Z were not so fortunate, as was later reported:

> Took off in company with 6A [Barnes] and was last seen engaging one of a pair of Ju 87s. The enemy rear gunner hit the water cooler of 6Z but was then shot down by S/Lt Lowe and seen to crash into the sea. At the same time another Ju 87 got on his tail, wounding S/Lt Lowe in the shoulder and killing LA Kensett. S/Lt Lowe immediately broke away, but at the same time his engine stopped and he made a forced landing into the sea. S/Lt Lowe cleared himself with difficulty and went to the rear cockpit and found his air gunner under water and obviously dead. He was unable to release him before the machine sank. S/Lt Lowe was picked up after about 20 minutes by HMS *Jaguar*.

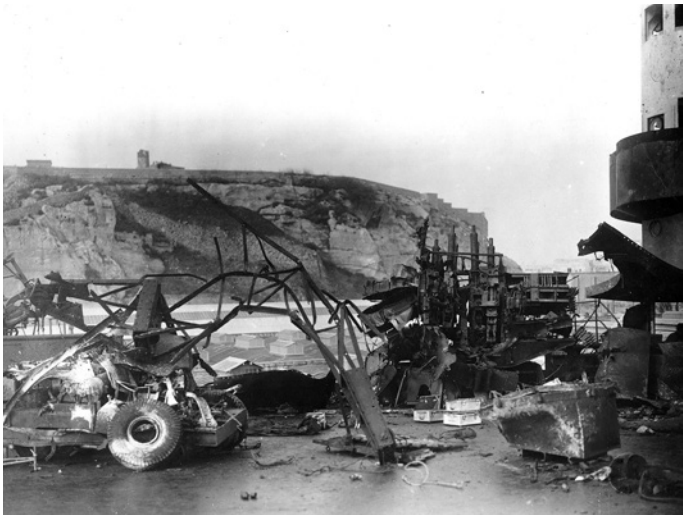
Five Ju 87s were claimed shot down by the British, three by anti-aircraft fire, but X. *Fliegerkorps* reported only three as lost.

Illustrious endured further aerial assaults from enemy aircraft, but these were not on the scale of the main strike by Ju 87s. The first of these subsequent attacks was described as 'inaccurate', with bombs being scattered. The carrier was forced to withdraw to the relative 'safety' of Malta Dockyard, 64 nautical miles away, and speed increased to 20 knots. But at 1350 hrs, the carrier was once again out of control and began to swing rapidly to port. By 1435 hrs it was back under control, steered by its engines.

A fourth, and final, attack was mounted in two waves at 1604 hrs by around 15 Ju 87s with a small fighter escort. Both the 4.5in. guns and five pom-poms engaged with controlled and barrage fire, despite vision being obscured by the smoke and haze caused by the fire in the hangar. Only two bombs fell near the ship, but in the second wave nine bombs were dropped, of which one hit the after lift, causing casualties among those tending the wounded and putting out fires. There were also two very near misses. Despite circling around the stern of *Illustrious*, a further attack was ultimately directed at the battle fleet with high-level and dive-bombing.

Illustrious reached Malta that evening still burning, but under its own power. The carrier had to be towed, listing and down by the stern, through the entrance to Grand Harbour at Valletta. It passed St. Elmo Breakwater Light at 2104 hrs and berthed starboard side to Parlatorio Wharf at 2215 hrs. It had lost 83 crew, with 60 seriously wounded and a further 40 lightly wounded, including several officers.

The damaged after lift well, looking from the hangar to the port quarter following the Stuka attack on *Illustrious*. The blast from the bombs caused a large number of fragment holes and tore the ship's side open in two places. (Robert Forsyth/ ADM267/83)



The skeletal remains of the flightdeck travelling crane on board *Illustrious* after it had reached Malta. This was the damage caused by the third bomb to hit the carrier. Behind it is the burnt-out S.2 pom-pom. (armouredcarriers.com)

Hauptmann Paul-Werner Hozzel, the *Gruppenkommandeur* of I./StG 1 whose Ju 87s tried in vain to sink *Illustrious* at Valletta at the cost of several 'thoroughly trained and experienced pilots and their back seaters.' Hozzel is seen here later in the war as an Oberstleutnant following the award of the Oakleaves to the Knight's Cross on 14 April 1943. (EN Archive)

All wounded men had been got away by 0200 hrs and the dead by 0300 hrs, when the fires aft were finally extinguished.

According to Boyd's post-action report, the pom-poms proved 'admirable, and in the course of six attacks [that day – dive-bomber, torpedo-bomber and high-level], five guns fired 30,000 rounds without failure.' However, Boyd was critical of one aspect. 'The method of control is, however, useless, except to put up a barrage. As many as six aircraft at a time were visible in the sights, and even with officers acting as Trainer and Gunlayer, it was impossible to ensure their coordinated effort being directed on any one target.'

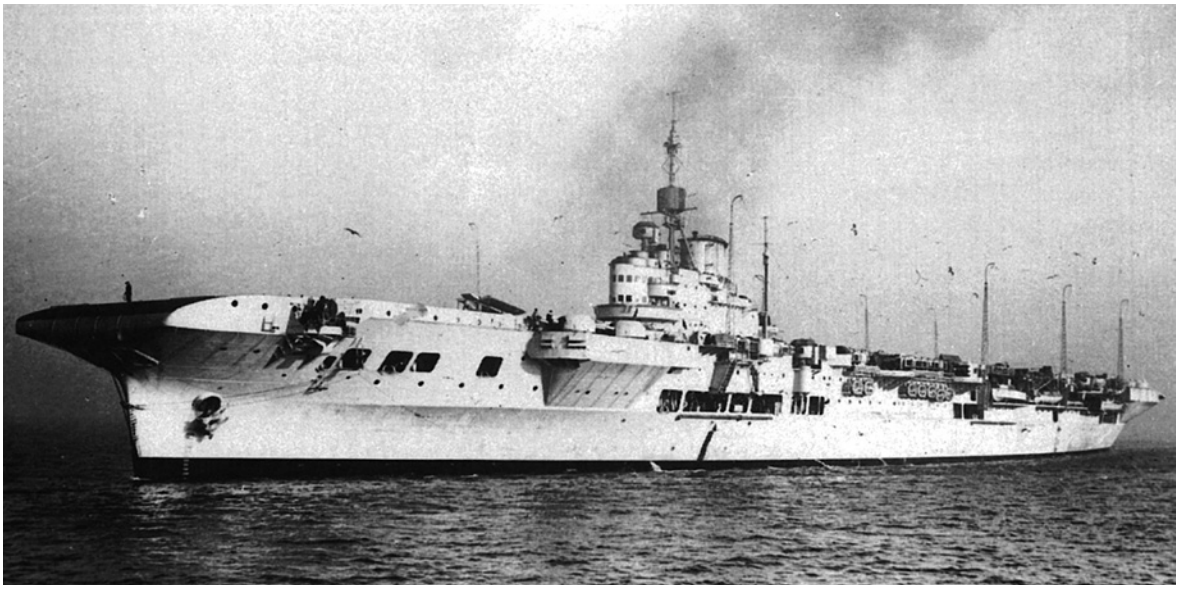
It was also Boyd's recommendation that a one-man Director and/or local sight with automatic power follow-up of the mounting was essential. Furthermore, 'The operation of a sight against dive-bombers requires considerable strength of character. It is considered that the quarter bill should be adjusted to allow the right type of officer for this duty. No instrument which cannot be set and operated entirely automatically is worth fitting at the Director or gun.'

Writing in the official history *The War at Sea*, Capt S. W. Roskill opines of *Illustrious*, 'It is probable that only her armoured flightdeck saved her from destruction'. But Malta offered little security. While Hozzel acknowledged the fact that towing *Illustrious* to the dockyard was a 'brave feat', the staff at X. *Fliegerkorps* recognised that, despite the strong anti-aircraft and fighter defence covering Valletta, the carrier had become a sitting target, and thus ordered a campaign of aerial bombardment in another attempt to sink it. Hozzel recalled:

> This aircraft carrier had become a matter of prestige for the high command of the Luftwaffe, also a precedence. It had to be sunk under all circumstances. If the high command could have reported the sinking of an aircraft carrier by German Stukas, both friend and foe would have taken notice. So commenced our attacks, with heavy losses, against the aircraft carrier in Valletta.

The Stukas came in day after day, bombing the docks and the carrier's berth at Parlatorio Wharf. On 16 January, during a strike by 44 Ju 87s, a 500kg bomb exploded close to the already damaged after lift well. Three days later, a total force of 42 Stukas targeted the carrier in two waves at around 1015 and 1310 hrs. The first wave saw some very near misses, but according to Boyd's report the second attack was noticeably less determined, with bombs dropped wide.

'In Valletta, more than 90 anti-aircraft batteries of all calibres spat their fire against us', recorded Hozzel. 'At the same time, Hurricanes seriously interfered with us on the approach route and after our departure. In practically every sortie I lost three or four of my old, battle-tested crews – an irreparable loss. It was just impossible to replace



Formidable photographed in 1940. On 26 May 1941 the carrier endured an assault by the Ju 87s of Major Walter Enneccerus's II./StG 2. It remained functioning despite the damage inflicted, but suffered the loss of 12 crew killed or missing and another ten wounded. The carrier was forced to retire from operations. (Angus Konstam)

those thoroughly trained and experienced pilots and their backseaters. Still we did not succeed in sinking the carrier.'

The defences claimed '19 certain [enemy aircraft], 3 probably and 4 damaged, of which 8 were attributed to gunfire.' It is believed the Luftwaffe actually lost five Ju 87s in the raid on the 19th.

Eventually, *Illustrious* sailed for Alexandria and then later for repair in Norfolk, Virginia. It did not re-join the fleet, in home waters, until March 1942.

To replace *Illustrious*, the Royal Navy despatched *Formidable* to the Mediterranean, where it arrived in January 1941 – just two months after entering service – and quickly became engaged in combat operations. On 28 March, *Formidable* was involved in what has become known as the battle of Cape Matapan, during which its Fulmars, Albacores and Swordfish carried out attacks on the Italian fleet, damaging the battleship *Vittorio Veneto* and the cruiser *Pola*. In April, the vessel was involved in covering troop convoys during the evacuation of Commonwealth forces from Greece, but by 12 May the carrier was in Alexandria, its Fulmar fighter contingent having been reduced to just four operational aircraft as a result of earlier convoy covering runs to Malta. Thus, the ship had been unable to engage in initial operations off Crete against the German landings and occupation there.

The unsuccessful defence of Crete had cost the Royal Navy dearly, with Luftwaffe air attacks taking a toll of British warships. On 22 May the cruisers HMS *Gloucester* and HMS *Fiji* were attacked by Ju 87s from I. and III./StG 2, which inflicted damage. Nevertheless, both vessels were then sent to cover the evacuation from Crete. *Gloucester* was then attacked again, this time by Stukas from 3./StG 1, set on fire, and sank shortly thereafter west of the Kirthera Channel, while *Fiji* was finished off by fighter-bombers and sank to the south of Crete. The following day, the destroyers HMS *Kashmir* and HMS *Kelly* were sunk by 20+ Ju 87s of Hauptmann Hubertus Hitschhold's I./StG 2. For the Allies, it was imperative that the Royal Navy arrest the Stuka threat in the area, principally by attacking the base of III./StG 2 (led by

Hauptmann Heinrich Brücker) at Scarpanto (Karpathos) from which attacks were being made against Heraklion and other ports along the southern coast of Crete.

Eventually, a force of 12 Fulmars (a 13th was declared unserviceable) equipping 803 and 806 NASs was scraped together, plus seven Albacores and eight Swordfish, and *Formidable*, commanded by Capt Arthur Bisset, sailed at midday on the 25th to Crete escorted by two battleships and seven destroyers as Force A. This force, which was viewed as being sufficient to cover the fleet and launch an air strike, reached a position 87 nautical miles south of the island of Scarpanto, to the east of Crete, early on the morning of the 26th. Cunningham, however, was concerned, and had warned the Admiralty that 'The Navy could not guarantee to prevent seaborne landings without suffering losses, which, added to those already sustained, would very seriously prejudice our command of the Eastern Mediterranean.' His concern was batted away, and he was told that the Mediterranean Fleet and the RAF must 'accept whatever risk' might arise to prevent the Germans and their Allies from consolidating their hold on Crete.

Thus, in the early hours of 26 May, just four serviceable Albacores dropped their 40lb and 250lb general purpose bombs in dives in the darkness on Scarpanto, followed by four Fulmars that made diving strafing runs along lines of Ju 87s and CR.42s parked closely together. All aircraft returned safely and Force A withdrew quickly to the south. When some 135 nautical miles south of the Strait of Kasos, however, the battle fleet ran into trouble during the early afternoon. From 1240 hrs onwards, an echo had been picked up by *Formidable*'s radar at 230 degrees at a distance of 75 nautical miles. By 1253 hrs it was closing on Force A, having been identified as 'a large group' of aircraft.

In circumstances of unanticipated coincidence for both sides, the 20 Ju 87s of Major Enneccerus's II./StG 2 happened to be flying over the sea off North Africa while searching for British supply ships heading for Tobruk. All the Stukas were fitted with long-range tanks, but had almost reached the limit of their range. At some point, crews

Fitted with 300-litre drop tanks, a Ju 87R-2 of II./StG 2 passes low over the waters of the Mediterranean in late 1941. This aircraft, T6+AC, was flown by the *Gruppenkommandeur*, Major Walter Enneccerus, and is adorned with the palm tree and Luftwaffe eagle emblem used successively by 4. *Staffel* and II. *Gruppe* while in North Africa. The fuselage band is in the Mediterranean theatre colour of white and the spinner in a lighter green. (EN Archive)

from 5./StG 2, under Oberleutnant Bernhard Hamester, spotted the ships of Force A. Enneccerus acted quickly and ordered the aircraft of 4. *Staffel*, under Oberleutnant Eberhard Jakob, and 6. *Staffel*, under Oberleutnant Fritz Eyer, to join 5. *Staffel* to target the carrier in *Gruppe* strength. Enneccerus would lead. Equally quickly, at 1310 hrs, *Formidable* turned into the wind to fly off its two remaining serviceable Fulmars.

Eleven minutes later, the guns of *Formidable* opened fire and the carrier altered course 90 degrees to starboard to bring the Ju 87s onto its beam. At 1325 hrs, the first bombs struck the water near the carrier, with a near miss on the starboard beam amidships. At 1327 hrs a 'large bomb' hit the ship on the wind screen, 26½ft to starboard of the centreline, passing through four decks and exploding in the capstan machinery compartment, causing fire to break out. A report prepared by the Director of Naval Ordnance after the ship was later repaired at Norfolk, Virginia, suggests this was most probably a 1,000kg bomb. The flames were extinguished after some ten minutes, but the damage caused forced a reduction in maximum safe speed to 17 knots. But this was not to be the end of it, as Bisset later recounted:

> Two minutes later, another bomb hit the ship just outside X.1 turret, passed through X.1 gun bay and out into the sea, where it exploded under water, just abaft the starboard propeller. This explosion shook the ship from end to end and the lurch put the RD/F [radio direction finder – radar] out of action for five minutes.

At 1332 hrs, *Formidable*'s guns stopped firing, and for the next 20 minutes the Ju 87s attempted two more attacks, but neither developed beyond an approach towards the carrier. In the meantime, the two Fulmars of Brown Section from 806 NAS had been unable to intercept the Stukas before they made their initial attack, although they did manage to claim one shot down as the dive-bombers withdrew. They also damaged two others to the extent that it was believed neither aircraft would have been able to return to base. The Fulmars succeeded in landing back on board *Formidable*, but not without first being attacked by four Bf 110s, as a result of which the air gunner of 'Brown 2' received four bullet wounds in one of his legs.

Twelve of *Formidable*'s crew were listed as killed or missing, with ten more wounded, as a result of the air attack. One Ju 87 of 5./StG 2 is believed to have been lost, with its gunner, Oberfeldwebel Ewald Krüger, wounded.

During this assault, the screening destroyer HMS *Nubian* was also struck by bombs, leaving its aft depth-charge stowage area on fire, destroying the X and Y gun mounts and blowing away the vessel's stern.

By evening *Formidable*, whose armoured-box hangar had survived the attack, was able to launch its fighters once more, but at 2115 hrs, under orders from Cunningham, the carrier was detached for Alexandria along with the destroyers HMS *Decoy*, HMS *Hereward*, HMAS *Voyager* and HMAS *Vendetta*. *General der Flieger* Wolfram von Richthofen, commanding VIII. *Fliegerkorps*' assault on Crete, noted in his diary on 26 May, 'The carrier received three hits from 500kg bombs. It soon turns tail for home. Our Crete–Libya pincers are effective for the first time.'

Not surprisingly, the removal of *Formidable* from the Crete battle area left air cover over the evacuations dangerously inadequate. Furthermore, convoys were immediately vulnerable, and on the 27th, one bound for Souda Bay was ordered to turn back.

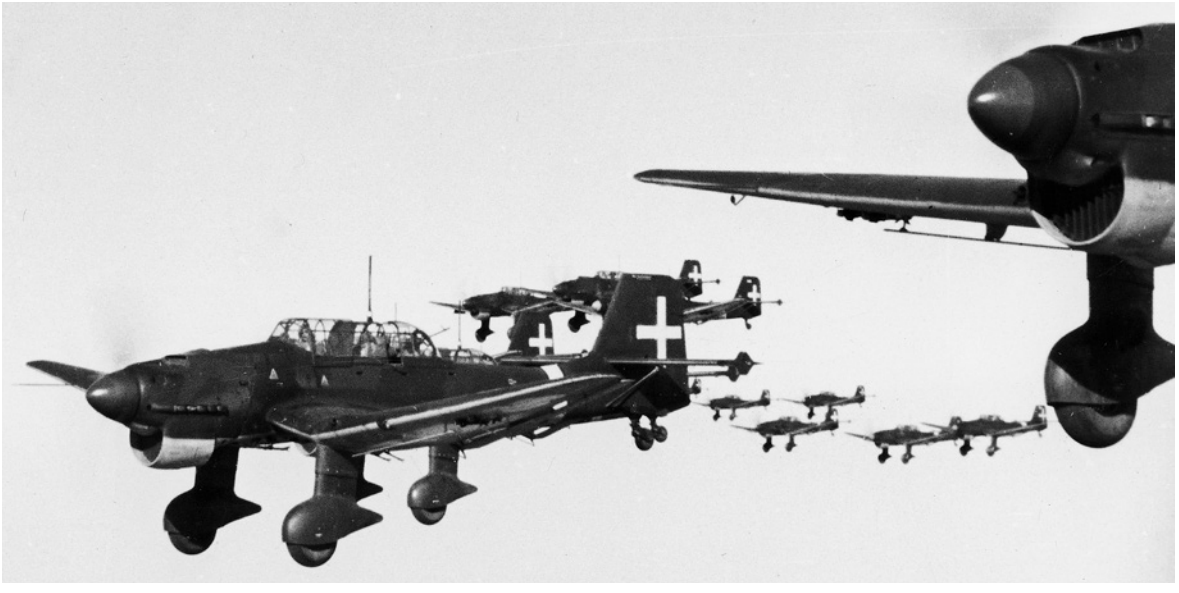
The same day, the battleship *Barham* was damaged by formations of He 111s and Ju 88s from II./KG 26 and II./LG 1.

Owing to the extent of the damage to *Formidable*, and the lack of available repair facilities, like *Illustrious*, it had to sail via Suez to the Norfolk Naval Shipyard in Virginia. Work was eventually completed in December 1941, but on the 16th of that month *Formidable* collided with *Illustrious* in bad weather and had to be further repaired in Britain before sailing to join the Eastern Fleet.

Throughout late 1941, the balance of power in the Mediterranean was precarious for Britain as Malta came under unrelenting bombardment by the Axis air forces. By December, only Force K, a naval squadron that had been formed in October and which used the island as its base, remained in the central region to attack convoys supplying Axis forces in the Western Desert. But this force had destroyed only two convoys before it suffered the damage or loss of three cruisers and a destroyer in a minefield off Tripoli. It would not be reformed until January 1943.

Such setbacks at sea and in the air undermined the gains of Gen Sir Claude Auchinleck's Operation *Crusader* offensive, and in early 1942, Generalleutnant Erwin Rommel's Afrika Korps was able to strengthen its resources for its planned spring and summer offensives. But the seesaw nature of the Mediterranean theatre saw the Allies gradually effect a stranglehold on Rommel's supplies as a result of Ultra intelligence, and following the fall of Tobruk in June, the British Eighth Army had been supplied with American tanks.

Pedestal begins. *Indomitable* photographed from *Victorious*, while in the distance is *Eagle* as the carriers sail eastward in the Mediterranean in August 1942. Two Sea Hurricanes, probably from 885 NAS, are visible on *Victorious* as an Albacore of either 827 or 831 NAS takes off from *Indomitable*. (Robert Forsyth)



Twelve Ju 87B-2s of 97° *Gruppo* were photographed either during a ferry flight or whilst returning from a mission. Operational from November 1940, 97° *Gruppo* was the second such unit of the Regia Aeronautica and the first to go to North Africa. Known by their crews as *Picchiatelli*, the Italian Stukas carried out a series of attacks against Tobruk, on the docks at Valletta and against Allied convoys carrying supplies to Malta and Alexandria. They inflicted considerable damage to the defences of Malta, but once the Allies increased their fighter strength in the Mediterranean, they incurred heavy casualties. (EN Archive)

On 8 August, the carrier *Indomitable*, under the command of Capt Thomas Hope Troubridge, which had arrived off Gibraltar from the Eastern Fleet, joined the other carriers *Victorious* and *Furious* from the Home Fleet and *Eagle* and *Argus* from the powerful Gibraltar-based formation Force H. Crews from these vessels were to plan, practice and coordinate operational procedures and take on aircraft, before sailing into the Mediterranean as escort for a supply convoy to Malta of 13 large and fast merchantmen and a tanker under the codename Operation *Pedestal*.

Rear Admiral Arthur Lumley Lyster's carrier squadron comprised *Indomitable*, *Victorious* and *Eagle* with 72 fighters, which would be supplemented by 38 Spitfires being ferried to Malta on board *Furious*. The carriers were part of an unprecedented overall escort force that numbered two battleships, seven cruisers and 24 destroyers intended to provide cover sufficient to deal with the anticipated Axis response. *Eagle* embarked Sea Hurricanes, while *Victorious* had both Fulmars and Sea Hurricanes. On board *Indomitable* were the Sea Hurricanes of 800 and 880 NASs, Albacores of 827 and 831 NASs and Martlets of 806 NAS. The convoy and its escort passed through the Straits of Gibraltar on the night of 9–10 August.

Commencing at noon on the 11th, *Pedestal* was harried by everything the Axis could muster – Italian and German submarines, E-boats and aircraft. *Eagle* was sunk by U-73 and the refrigerated freighter *Deucalion* was damaged by air attack. Yet, by this stage of the war, it is significant to note that of some 650 aircraft available to the Luftwaffe and the Regia Aeronautica, fewer than 40 were Ju 87s – a sign perhaps that the Stuka's effectiveness was ebbing, and also that its effectiveness was better used elsewhere, such as on the Eastern Front combatting tanks.

The first Ju 87s to be deployed against *Pedestal* were from the Italian 102° *Gruppo* based on Pantelleria. The dive-bombers, known by their crews as *Picchiatelli*, were in a position to directly attack the convoy. They did so at 1840 hrs on the 12th when nine Ju 87s led by Capitano Antonio Cumbat dived down on the battleship HMS *Rodney* and the cruiser HMS *Cairo*. The Italian crews scored near misses, but no hits,

Oberleutnant Martin Moßdorf, acting *Kommandeur* of I./StG 3, who led the Stuka attack against *Indomitable* on 12 August 1942. He wears the Knight's Cross, which he was awarded on 3 September 1942, as well as the silver mission clasp for having completed 60 operational flights. (EN Archive)

and two of their aircraft were lost, one being downed by anti-aircraft fire and crashing off *Rodney*'s port bow.

By 1845 hrs on the evening of the 12th, the convoy had endured three air attacks. Amidst fine weather and a calm sea, with no cloud, *Indomitable* was southwest of Sicily, steaming at 22 knots. The scene was set for another clash between a carrier of the Royal Navy and the Luftwaffe's Ju 87s.

In readiness to engage *Pedestal*, just under 30 Ju 87s – a mixed force of R and newer D models – of I./StG 3, led by Oberleutnant Martin Moßdorf, had transferred from North Africa to Trapani and Sciacca in Sicily. Moßdorf, known as *'Moskopf'*, was a highly experienced Stuka pilot who had joined the Luftwaffe in 1936, first flying the Hs 123 as a trainee ground-attack pilot. As an Oberleutnant, he had flown in Poland with 3./StG 76 and in France in 1940, by which time his unit had been redesignated 3./StG 3, and subsequently in the Balkans. His *Staffel* then saw action over Crete, before being despatched to North Africa in November 1941 to cover the retreat of Rommel's forces. Moßdorf was appointed *Staffelkapitän* of 3. *Staffel* in early 1942, and awarded the *Deutsches Kreuz in Gold* on 19 March of that year. In June, following the death of the *Gruppenkommandeur*, Hauptmann Heinrich Eppen, Moßdorf took the role of acting *Kommandeur*.

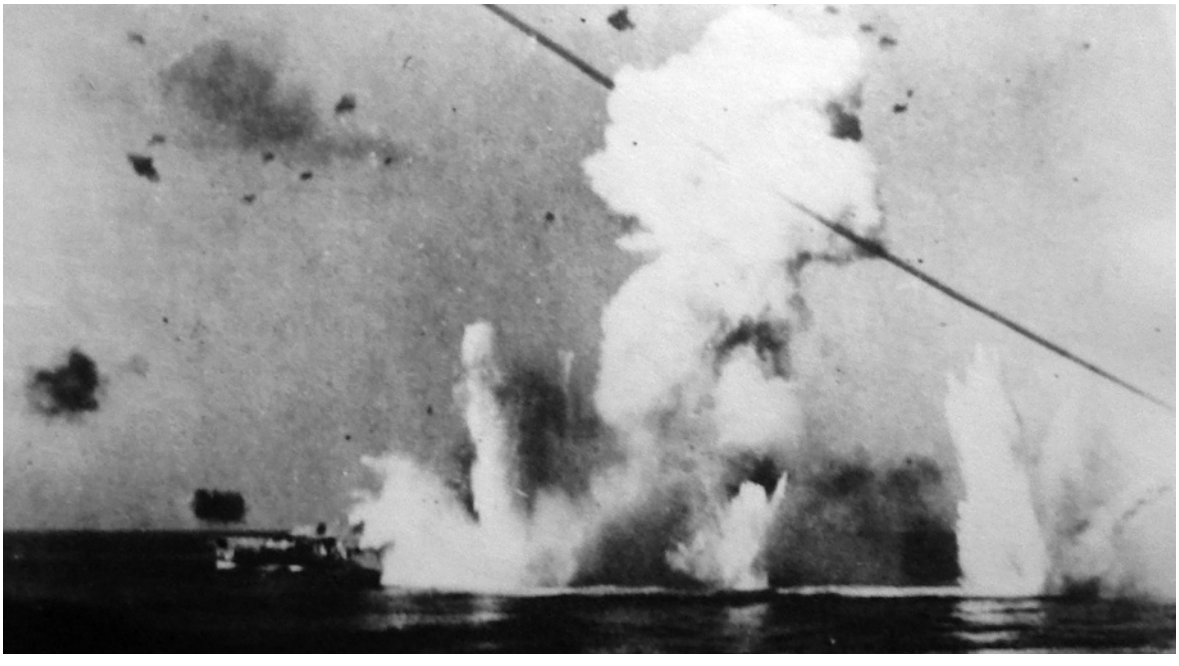
Leading a formation of around 12 Ju 87s, Moßdorf headed out from Sicily towards the convoy. Sailing as part of the *Pedestal* convoy was the light anti-aircraft cruiser HMS *Charybdis*, on which was serving gunner David Royle. He recounted:

> Accordingly, with darkness now almost upon us, the fighters started landing on. I saw the last fighter land on *Victorious*, then, in the faint night sky, I saw a group of black dots 1,500ft overhead. They started to peel off, one after the other, in vertical dives. I realised they were Ju 87s, and they were diving on the carrier *Indomitable*. Although *Charybdis* was too far away from *Indomitable* for our close-range fire to be effective, I opened fire with the single port pom-pom, hoping the tracer would warn *Indomitable* and her closer escorts. Heavy AA fire started at once, but these Stukas were the Luftwaffe's special anti-ship dive-bombers.

Indomitable had just sent 14 fighters up to meet what was estimated to be a force of some 100 enemy aircraft when the Ju 87s 'appeared suddenly up sun out of the smoky blue sky, which was rendered hazy by funnel gases'. The Stukas commenced their attacks from astern at 15,000ft before the carrier could bring its guns to bear. The dive-bombers were observed to release their bombs in a 70-degree dive, the first from 1,500ft, the others from lower heights, before passing over the carrier at heights of between 500-1,000ft without firing their guns.

What was believed to have been an SC250 bomb struck the flightdeck six feet to starboard of the forward edge of the forward lift and made a hole 14in. in diameter. It perforated the upper gallery deck and detonated just above the upper hangar deck after travelling 16ft from the point of its first impact. The lift was canted upwards five feet on the starboard side and nearby electrical equipment was so badly damaged that it required almost complete replacement. The lift's differential gear was also damaged. A hole 20ft x 12ft was blown upwards in the upper gallery and another 20ft x 28ft downwards.

Fire also broke out, with petrol being set alight at the forward end of the hangar, although this was under control within 40 minutes. The fire was below the A.1 turret,



Indomitable is almost lost amidst the bomb bursts of I./StG 3's attack during the evening of 12 August 1942 southwest of Sicily. (Robert Forsyth/ ADM267/84)

and no heat reached the A.2 position. In A.1, cordite exploded and split the cylinders, with a shell falling through the damaged deck into the fire, where it exploded. Some of the ship's bulkheads broke away or bulged and splinters flew for some 30ft.

A second SC250 penetrated the flightdeck on the middle line abaft the after lift, passed through the upper gallery deck and detonated just above the upper hangar deck in the cabins adjacent to the No. 2 torpedo body room, having also travelled 16ft from the point of its first impact. A large hole was blown upwards through the flightdeck following the explosion and a fire broke out, although the latter did not ignite the torpedo warheads in their mantlet stowages.

A near miss carved a groove in the lower edge of the pom-pom director's bulwark at 63 station, port side and detonated in the air five feet from the ship's side at the level of the upper hangar deck after it too travelled 16ft from the point of its first impact. Some of the ship's side plating was destroyed and the longitudinal bulkhead of the wardroom was torn from its welded connection. Splinters reached up to 52ft within the ship. Another bomb struck the sea about 25ft from the ship's side abreast 125 station on the port side and detonated at an estimated depth of 25ft, flooding all wing compartments between 113 and 139 stations – a length of 104ft. The ship's side was also blown inwards along a length of 48ft between some bulkheads. Another hole was blown inwards from the lower deck to the bottom of the shaft passage to a girth of 30ft. Approximately 760 tons of water poured into the ship, causing a heel of eight degrees.

David Royle on *Charydbis* recalled:

> *Charydbis* steamed over to her at high speed, and as we approached she appeared to be on fire from stem to stern. Smoke was billowing out of her hangar lifts and what I thought was the flightdeck, dripping molten metal [this was actually blazing aviation

Indomitable's 4.5in. guns point skywards as engineers and members of the ship's crew survey the damage from the first of the Stukas' bombs, which hit the aft flightdeck. This photograph shows the view looking starboard during emergency repairs at Gibraltar on 15 August 1942. (Robert Forsyth/ ADM267/84)

fuel]. The *Indomitable* was temporarily out of control, and *Charybdis* circled her ready to go alongside if need be. It appeared that the Fleet had been caught out by the Stukas' attack.

This was not quite the case, for Sea Hurricanes of 800 NAS from *Indomitable* were in the air during the attack. At 1840 hrs Sub-Lt Andy Thomson dived from about 6,000ft to mount an attack on the last Ju 87 in a formation of four. Thomson went below the Junkers and then pulled up, opening fire with a five-second burst from 130 yards astern. The dive-bomber did not have time to take evasive manoeuvres and went down into the sea. Twenty minutes later, Sub-Lt Blythe Ritchie attacked a group of five Ju 87s at 2,000ft from slightly above. 'I did a beam attack', he later recalled, 'ending up on quarter of enemy when my ammunition ran out. He was diving to attack shipping and just kept on going till he hit the sea.' Ritchie's aircraft took a bullet just behind his head from the rear gunner in the Ju 87 to join the 'numerous holes from anti-aircraft fire of fleet'.

The Sea Hurricane pilot observed how the enemy 'pilot's cockpit was shattered. I think the pilot of the enemy aircraft was killed when I hit his cockpit. His angle of dive changed from 60 to 80 degrees approximately. The rear gunner may have survived, as, just when I turned away, he stood up in the cockpit. Enemy jettisoned his bombs before he went into the sea.' Ritchie claimed two other Stukas in that action, including one at 1850 hrs in which the 'gunner of enemy aircraft was seen to double up over gun when I was astern of him and almost finished my attack. Enemy aircraft was seen going into

Sea Hurricanes from 800 NAS prepare for launch as *Indomitable* approaches Gibraltar following its participation in the *Pedestal* operation. The aircraft nearest to the camera is P5206, which Sub-Lt Andy Thomson used to shoot down a Ju 87 and a Bf 109 on 12 August 1942. (Andrew Thomas Collection)

sea by personnel of *Victorious* and *Indomitable*, as well as by me. I did not perceive any survivors.'

Indomitable suffered the loss of 50 crew killed as a result of the explosions, including six officers, one of them a Sea Hurricane pilot. A further 59 personnel were seriously wounded. The carrier's fighters were transferred to *Victorious*.

Pedestal was an epic attempt to supply Malta, but it was also a costly one. Just five of the 14 merchantmen arrived. With its fighter protection removed as the carriers returned to Gibraltar, the convoy was to suffer badly through its vulnerability to air attack, although 32,000 tons from the 85,000 tons of vital supplies and fuel loaded did reach the island as a result of the effort, meaning it could hold out. One aircraft carrier, two cruisers and a destroyer had been sunk, and a carrier and two cruisers badly damaged.

Three weeks after the attack on *Indomitable*, on 3 September 1942, Oberleutnant Martin Moßdorf was awarded the Knight's Cross in recognition, primarily, of 160 successful operational missions, but the attack on the carrier would, undoubtedly, have improved his prospects for the award.

The aftermath. The result of the first near miss, and the damage caused to *Indomitable*'s port side, photographed looking slightly aft while undergoing repair at Gibraltar on 15 August 1942. (Robert Forsyth/ADM267/84)

Summarising in his post-action narrative, Capt Troubridge remained optimistic:

> So ended a great day. The number of sorties flown was 74, which is thought to be a record for aircraft carriers, and would have been 78 but for the bombing. All the pilots went up twice and some three times – they responded to every call. The men in the hangars and on the flightdeck worked without a break for 14 hours, being then called upon to fight the fires and repair the damage from the enemy bombing attack. The teamwork between *Victorious* and *Indomitable* was one of the outstanding features of a notable day, and largely contributed to the fact that when, at 1900 hrs, in accordance with the plan, the carriers withdrew westward, the convoy and its escort was, with the exception of one merchant vessel bombed at 1230 hrs, proceeding to its destination unhindered by anything the enemy had been able to do from the air. Fighter carriers had proved their worth.

Carrying 50kg underwing bombs, Ju 87D-3 S7+AA of Oberstleutnant Walter Sigel, *Kommodore* of StG 3, taxies out at a landing ground in North Africa in 1942 or early 1943. (EN Archive)

STATISTICS AND ANALYSIS

In the Luftwaffe's early campaigns, the Ju 87 proved itself to be a potent aircraft. During the late 1930s and into the first three years of the war, dive-bombing was held as a precision tactic. In 1943, the Czech Silesian military theorist Capt Ferdinand Otto Miksche, serving with the Free French, wrote, 'In dive-bombing, the accuracy of the aim, of course, is much greater than in any other form of bombing, and almost approaches the precision of an artillery bombardment. Nature herself has furnished us with a model of diving. Like a bird of prey, the machine hurls itself on its victim.'

Indeed, in Spain, Poland, the Low Countries, France, the Balkans and the Soviet Union, the Ju 87 regularly and successfully demonstrated this 'art' against small and

Blue skies, dark waters. The forlorn sight of *Eagle* listing, having been struck by torpedoes on 11 August 1942. No carrier, Axis or Allied, was invulnerable to torpedoes or bombs in World War II. (Robert Forsyth/ADM267/84)

pinpoint targets such as tanks, trains, road junctions, buildings, bridges, fortified positions and ships. But in the Mediterranean, against the Royal Navy's armoured aircraft carriers, it was a different story. It took anything between ten and 20 Ju 87s – that is to say *Staffel*- or *Gruppe*-strength formations – to cause significant damage to a carrier. Bombs of 250 and 500kg *did* inflict damage, but they would often fall in water at a distance too far from the target to cause any telling damage. The bombs of between 250 and 1,000kg that did strike home with sufficient effect to prevent or interrupt operations were probably dropped by more experienced pilots. Only one carrier, *Eagle*, was sunk in the Mediterranean, and that was by a U-boat.

A sight which would have been the cause for alarm to the crews of Allied warships and merchantmen – a formation of bomb-laden Ju 87s of StG 2 heading out for another mission over the Mediterranean or North Africa. (EN Archive)

Furthermore, in the cases where British carriers were sunk or damaged by air attack, they were operating with limited air cover of their own and at some distance from the nearest land-based support.

Nevertheless, in addition to their successes against other ships, as well as ground-attack work in the Balkans and North Africa, the Stuka units were partly, if not wholly, responsible for the removal from operations of *Illustrious*, *Formidable* and *Indomitable*, thus eliminating, for periods, British carrier air power at critical points in the war in the Mediterranean. This had the effect of leaving supply routes vulnerable to further attack.

During the Stuka attacks on *Illustrious* on 10 January 1941, some 3,000 4.5in. HE shells were fired at a rate of around 12 rounds per gun per minute. But despite this, the Ju 87s got through. In terms of defence, the carriers' 4.5in. guns were reliant on HACS, which calculated an 'aim-off' on the basis that an aircraft's height, speed and course would be constant. However, in a dive-bombing attack this was not the case, and thus HACS could only be used to set up a barrage of exploding shells through which a Ju 87 would have to fly to get close enough to the carrier to effect a hit. The aim-off was set by the control officer with the HACS director forward area sight (HADFAS). However, it was noted:

> The HADFAS is of no use when engaging dive-bombers; control officers are all agreed that when engaging aircraft in barrage fire they look straight at them and use their vertical and lateral deflection handwheels to hosepipe bursts onto the target. This may or may not be sound in theory, but it is what happens, and, it is considered, always will happen when engaging large numbers of dive-bombers.

Following the January attacks on *Illustrious,* it was the opinion that the general layout of the 4.5in. gun bays, ammunition conveyors, chain hoists and directors was excellent, but that, 'When guns are fired across the flightdeck, as they frequently are, space in rear of mountings – i.e., on the outboard side of the gun bays – is very

Quadruple pom-poms and a single 20mm Oerlikon gun put up a barrage against enemy aircraft. The Oerlikon was an automatic weapon designed for close-range anti-aircraft fire, with an effective range of 1,000 yards. It was mounted on a single, shoulder-controlled mounting or on a twin, power-operated mounting, and being free-swinging, the gunner could follow his target easily, while his assistant raised and lowered the weapon in order for the gunner to point as high as necessary. (Robert Forsyth/ ADM267/84)

cramped. The difficulty of providing more space is, however, fully realised.'

The 40 Mk VIII Automatic High Velocity pom-poms, and their mountings, on *Illustrious* gave a 'remarkable' performance, and in no case did any gun suffer a major stoppage. Some did, however, occur when firing at extreme elevations due to empty cartridges jamming as they left the ejector tube. In one action, a very near miss that caused the ship to take a heavy list resulted in empty cartridges and links sliding under the mounting and jamming it in training. It was suggested that skirts should be fitted as a preventative measure. It was also recognised that 'the number of close-range weapons to be controlled is too large for the ADO to do himself, and it has been proved conclusively that a Fire Distribution Officer at each weapon is essential, and that they and not the ADO must distribute the fire.'

The post-action narrative prepared by *Illustrious* also highlighted a psychological aspect to a dive-bombing attack:

> The greater the stress under which a man is working, the more he is governed by his instinct and a desire to do the most natural and simple thing. This fact showed itself universally in *Illustrious* in the following ways:
>
> 1. Everybody in a position to do so was unable to avoid looking at the dive-bombers and, because it was easier to look straight at them than through a sight, only by a most conscious effort could one force oneself to adopt the latter course. A man does NOT look for the bead of his foresight when shooting a snipe because, at the moment, the bird is of such absorbing interest; large numbers of diving aircraft are at least as fascinating.
> 2. A man defending himself with a pistol does not ask for or pay attention to advice on how he should aim his gun when an attempt is being made on his life. He points it at his assailant and fires as and when HE thinks fit. In the same way layers, trainers and No. 1s of pom-poms each tended to trust themselves when they SAW diving aircraft attacking the ship. If they are to be expected to follow pointers and obey fire lights they must be UNABLE to see the aircraft.

The Control Officer's Forward Area Sight on the S.1 Director did in fact snap off on one occasion.

When *Illustrious* was attacked, most bombs fell outside of its armoured flightdeck. However, the armour was penetrated during the attack and bombs caused explosions within the closed hangar. The question remains whether an open-sided hangar with a lighter flightdeck might have evaded such damage and allowed the movement and quicker operation of aircraft, as opposed to 'containing' them. Seven bomb hits – six in one attack and a seventh in another – did not sink the carrier.

AFTERMATH

The development of armoured carriers with small units of aircraft embarked, operating in European waters and in the Mediterranean and the Far East, originated because of the threat anticipated from enemy surface ships and land-based aircraft in such areas. However, from 1942, the effectiveness of the carriers was limited when they were deployed in longer range, transoceanic operations.

After being repaired in the US, *Illustrious* subsequently saw service in support of the British landings in Madagascar in May 1942 and as escort to Prime Minister Winston Churchill on the RMS *Queen Mary* when he journeyed across the Atlantic to America in August 1943. The following month, its aircraft provided air cover for the Allied landings at Salerno. In 1944 the carrier was in the Indian Ocean, where its aircraft carried out strikes on Japanese bases in Burma. In February 1945, *Illustrious* was assigned to the British Pacific Fleet, and it gave support to the American landings on Okinawa. The vessel was damaged during a kamikaze attack on 6 April and returned home, ending the war in Rosyth. It was broken up for scrap in 1957.

Formidable was in Mombasa in May 1942 and took part in Operation *Ironclad* east of Diego Suarez to counter Japanese intervention in the region. On 30 July it went with *Illustrious* to the Bay of Bengal to draw away Japanese attention while the US Marine Corps landed at Guadalcanal. In November, *Formidable* was part of the covering force for the Allied landings in North Africa and was the only carrier to remain in the Mediterranean in early 1943, before moving to Sicily in July to cover the Allied landings there. It then returned to home waters, joining the Home Fleet, for which the carrier covered Arctic convoys and was involved in attacks on *Tirpitz*. In March 1945, like *Illustrious* it joined the British Pacific Fleet and was hit during a kamikaze attack on 4 May. Aircraft from the vessel carried out attacks on the Japanese mainland until war's end. *Formidable* replaced *Indomitable* as the flagship for the Flag

The flightdeck of *Illustrious* strewn with replacement plating while under repair at Norfolk Navy Yard, in Virginia, on 4 October 1941 following its encounter with Ju 87s on 10 January that year. Towering above the carrier's island is the drum-like Type 72 radar homing beacon and thermograph. On the neighbouring berth is the transport ship USS *Chaumont* (AP-5). (armouredcarriers.com)

Officer Aircraft Carriers, British Pacific Fleet, on 1 July 1945. It was eventually scrapped in Scotland in the early 1950s.

After repair at Norfolk, Virginia, and a spell in home waters, *Indomitable* joined Force H in Gibraltar and subsequently took part in the invasion of Sicily. On 16 July 1943 it was hit by a torpedo launched from a Ju 88 northeast of Malta and was forced to return to Norfolk for repairs for the third time in three years. After their completion, *Indomitable* joined the Eastern Fleet in the Indian Ocean in July 1944. Here, it became flagship for the Flag Officer, Aircraft Carriers, British Pacific Fleet, at Trincomalee and operated against targets in the East Indies. *Indomitable*, too, was the victim of a kamikaze attack southwest of Okinawa in May 1945, although it suffered only superficial damage. Ending the war in Australia, the ship soon returned home and in 1951 became the flagship of the Home Fleet. *Indomitable* was broken up for scrap in the mid-1950s.

The 13,700-ton *Hermes* was the only British carrier to be sunk by aircraft when it was attacked by Japanese D3A 'Val' dive-bombers, which scored 40 hits on the vessel, off Batticaloa, in Ceylon, on 9 April 1942. *Hermes* had been the first ship to be constructed from the keel up to operate aircraft.

By mid-1943, with the Ju 87 having undergone a transfiguration into a specialist anti-tank/ground-attack aircraft as the D and G variants equipped with 3.7cm underwing cannon, its role as a dive-bomber was almost redundant following a significant increase in enemy anti-aircraft defences, improved tank armour and fast

fighters, particularly on the Eastern Front. On 10 September 1943, Oberst Dr. Ernst Kupfer, a highly-decorated Ju 87 pilot and former *Kommodore* of StG 2, who had taken over the new appointment of *General der Schlachtflieger* (General of Ground-Attack Arm), met with Generalfeldmarschall Erhard Milch at the RLM in Berlin. He spoke plainly:

> Even today, unfortunately, people still identify the concept of the dive-bomber with a Ju 87 screaming down in a more or less vertical dive on its target. Slogans are always dangerous, and this concept has become a dangerous slogan. We of the dive-bomber arm have experienced this personally, to our regret. The dive-bombers are being used against anything and everything.
>
> Such a method of employment has its origins in the past, at a time when we had absolute air supremacy and at a time when the enemy's anti-aircraft defences were far less effective, in number and quality, than they are now. Dive-bomber forces can no longer be effectively employed against all these various targets. Under no circumstances can we justify the continued employment of the Ju 87 in the East or anywhere else.

Gradually, the Ju 87 was replaced in the ground-attack role by the faster, single-seat Fw 190F variant, while in 1943 the Luftwaffe's anti-shipping need was fulfilled by Ju 88 torpedo-bombers and Do 217s and He 177s carrying remotely controlled glide-bombs. Nevertheless, the Ju 87 soldiered on until the end of the war in limited numbers as a night ground-attack aircraft in Russia, Italy and in the West. While the aircraft and crews may have been valiant in their operations, by 1945 the Luftwaffe was a spent force.

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Ju 87 Stuka cover art
This Ju 87R-1 of 1./StG 1 is representative of the aircraft and units that carried out the attack on HMS *Illustrious* west of Malta on 10 January 1941. In addition to a 250kg centreline bomb, the aircraft carries two 300-litre underwing drop tanks for extended over-water operations, although for safety reasons these were never filled to more than 295 litres. With the incorporation of two additional 150-litre outer wing fuel tanks, which supplemented the existing self-sealing 240-litre wing root tanks, the Ju 87R-1 had a range of around 1,400 km. This machine is finished in a standard northern European scheme of RLM 70/71 greens with 65 undersides. The aircraft features the diving raven emblem of the I. *Gruppe* of StG 1 on its nose and the white Mediterranean theatre identification band around its fuselage. Thirty-nine Ju 87s from I./StG 1 and II./StG 2 were sent out to attack *Illustrious*. (Artwork by Jim Laurier)

Royal Navy carrier cover art
A Fulmar from 806 NAS takes off from the flightdeck of HMS *Illustrious* as part of the Force A convoy covering screen in the Mediterranean in early 1941. Commissioned just eight months earlier, *Illustrious* was the first of four fleet carriers in the class of its name. The ship was built with armoured flightdecks and hangars, a measure which adversely affected the capacity of the latter, but which gave the carrier protection against air attack. Further protection came in the form of its eight twin 4.5in. High-Angle guns (four forward and four aft) and six eight-barrelled pom-poms. The carrier could carry 86 aircraft in total. It endured intense air attack by Italian S.79 torpedo-bombers and Ju 87 Stukas on 10 January 1941, the latter type adding several near misses to the Italian crews' hits. One bomb dropped by the Ju 87s struck the after lift well, where it blew out fires in some areas. By this time *Illustrious* had been finished in a MS4a camouflage pattern. (Artwork by Jim Laurier)

Title Page
Ju 87R-2 S1+FH of 1./StG 3 banks away from another Stuka. The aircraft carries a 250kg bomb on its centreline attachment points and pairs of 50kg bombs fitted to ETC 50/VIII racks under each wing. (EN Archive)